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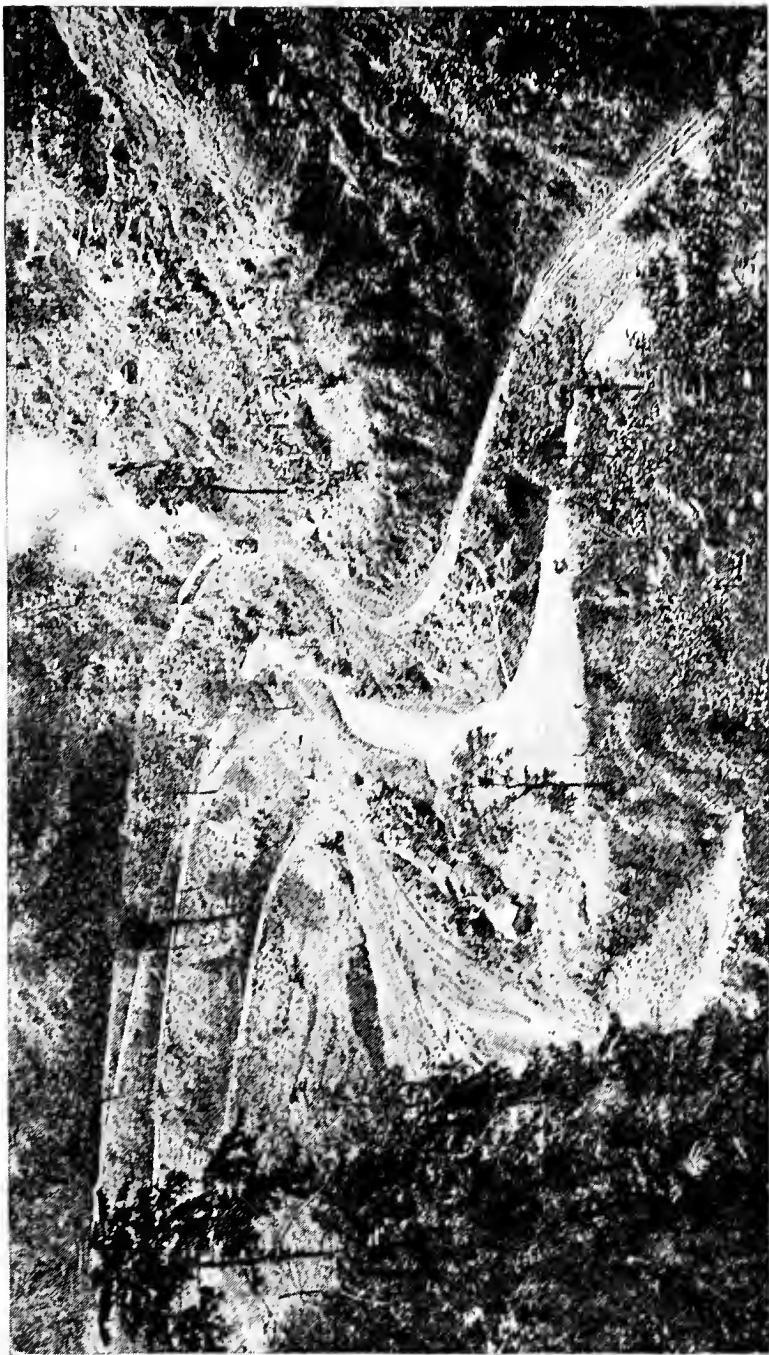
# LIGHT RAILWAYS

FOR THE

UNITED KINGDOM, INDIA, AND THE COLONIES







PARJELING RAILWAY GAUGE 2 FT

# LIGHT RAILWAYS

FOR THE

UNITED KINGDOM, INDIA, AND THE COLONIES

*A PRACTICAL HANDBOOK*

SETTING FORTH

*THE PRINCIPLES ON WHICH LIGHT RAILWAYS  
SHOULD BE CONSTRUCTED, WORKED, AND FINANCED*

AND DETAILING

*THE COST OF CONSTRUCTION  
EQUIPMENT, REVENUE, AND WORKING EXPENSES  
OF LOCAL RAILWAYS ALREADY ESTABLISHED IN THE  
ABOVE-MENTIONED COUNTRIES, AND IN BELGIUM,  
FRANCE, SWITZERLAND, ETC.*

BY

JOHN CHARLES MACKAY

F.G.S. A.M.INST.C.E.

Illustrated with Photographic Plates and other Diagrams



LONDON  
CROSBY LOCKWOOD AND SON  
7, STATIONERS' HALL COURT, LUDGATE HILL

1896



## P R E F A C E.

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THE construction of Light Railways, as distinct from the Main-line standard, has not found much favour in this country, and such lines are only to be found in a few isolated instances. On the contrary, however, nearly every other nation has long ago found out their usefulness, and assistance from public funds has been largely given towards their construction. In Belgium alone there are upwards of 700 miles of Light Railways, with a capital of nearly £2,000,000 sterling; while Hungary has also over 2300 miles, with a gross revenue of £663,000. per annum. Saxony, Switzerland, Italy, and France have all their local railways and tramways, and in Germany the system has been so far developed that a Light Railway periodical has been in existence since 1874.

The want of such railways in the United Kingdom may partly be attributed to our insular prejudice. We like “something substantial” in the shape of railways; we are wedded to high speeds and absolute safety in travelling; and under the paternal care of the Board of Trade the conditions imposed on the construction and working of local railways has hitherto rendered them financially impossible. During the past year a wave of opinion in favour of Light Railways has affected not only this country but our Colonies

also, and the cry from Ceylon, from Australia, from India, and from Africa has gone forth to their respective Governments for cheap means of communication to outlying districts.

In South Africa the Author had the honour of addressing a special meeting of the Chamber of Commerce in Port Elizabeth on "Little Railways for the Development of Poor Districts," on the day before the Light Railway Conference met at the Guildhall, in London, in 1894; and, later on, a special meeting of the Cape Town Chamber of Commerce; and although he had brought this matter prominently before the Cape Colony, the Orange Free State, and Natal, some twelve years ago, it was only last year that people became alive to the advantages of these railways as the only means, under the financial circumstances of the country, of placing the fertile districts of those Colonies in ready communication with the chief markets. Every district had wanted its main line of the standard type to serve its requirements; but it being impossible to construct a railway costing over £8000 per mile for traffic that would only support one costing £2000, the inhabitants had perforce to stick to their slow, cumbrous, but nevertheless useful, bullock-waggons.

The English Railway Companies, under the exigencies of our Acts of Parliament and the requirements of the Board of Trade—and in some cases under the fear of competition from other companies, and the pressure brought to bear upon them by different districts—have constructed branch lines on a scale far in advance of any traffic that is likely to come upon them for many years, and at such a cost that it is hopeless ever to expect a dividend on the capital expended. Our Colonies have done the same, but from other causes. The Consulting Engineers in England, the Managers and the Engineers of the Railways in the Colonies, have generally set their faces against the construction of any branch lines that were not equal to

the main lines of the Colony, as if they would sooner cut off a district from any railway communication at all than depart from the standard they had laid down for the main lines. In this there is hardly cause for surprise. Men who have had to deal with large schemes of engineering enterprise, involving the tunnelling of mountains, or the construction of colossal bridges, can hardly be expected to take to the planning of a railway limited to a cost of £2500 per mile, or to organize the details of traffic amounting, perhaps, to no more than fifty tons per day. Again, personal interests and political expediency have in many cases dictated the route and the standard of a railway abroad, and consequently every country is now saddled with branch lines that are only paying their working expenses, and, in some instances, not even these. The Commissioners of our Colonial railways say that all feeder branch lines must be constructed at as small a capital cost as possible, and yet they will not depart from the main-line standard.

The continued agricultural depression in England is compelling the farmer to turn his attention to anything that may benefit him, and he at last sees that cheap and rapid transport to available markets, and low freights, are the only means left to him to compete with those nations that have them. Our Colonists, living in districts not served by railways, cannot compete with their fellow-colonists having that advantage, and consequently they want a railway to serve them ; but if every district is to have one, the capital cost of the railway (as compared with present undertakings) must be considerably reduced, and the revenue to be derived from the working of it must be sufficient to pay interest on capital, after paying working expenses, in a reasonable time after construction—say in five years, so that the finances of the country may not be unduly taxed.

It is the object of the present work to show that this is by no

means such a difficult matter as many people suppose, and that were the same degree of common-sense brought to bear upon railway construction and working as is used in ordinary business matters, and were subsidiary railways treated entirely in a commercial spirit, we should have fewer unprofitable railways to-day, and many places which are now devoid of railway communication would be hearing the welcome sound of the railway whistle.

In compiling this volume, I have made liberal use of information bearing upon the question of "light" railways and "little" railways which has appeared from time to time in technical newspapers and periodicals, and especially in *Engineering*, the *Engineer*, the *Railway World*, *Transport*, the *Proceedings of the Institution of Civil Engineers*, the papers published by the International Railway Congress, and the Railway Reports of the different countries and Colonies mentioned in the work; while to several of the above-mentioned journals, as well as to private firms, I have to acknowledge my indebtedness for the loan of blocks of illustrations. The greatest care having been taken to ensure accuracy in all details, as well as comprehensiveness of treatment, it is confidently anticipated that the work will prove of material assistance to the large number of persons directly interested in this question of the hour.

The full text of the "Bill to Facilitate the Construction of Light Railways in Great Britain"—which has been introduced in the House of Commons by the President of the Board of Trade (Right Hon. C. T. Ritchie, M.P.), while the later sheets of the work were passing through the press—will be found set out in an Appendix.

EALING, W.

February, 1896.

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ERRATUM.

Page 221, line 5, for "Sir Alexander Rendal" read "Sir Alexander Rendel."

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# LIGHT RAILWAYS.

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## CHAPTER I.

### *LIGHT RAILWAYS CONSIDERED.*

IN talking about light railways many people at once jump at the conclusion that a light railway means a narrow-gauge railway, and the vision of a break of gauge at once obscures their faculties, and they dismiss the matter without further consideration. There is no reason why a light railway, if circumstances warrant it, should not be constructed on the standard gauge, and in speaking of light railways in any country they may be described generally, as railways constructed to a lighter standard than the main lines of the country, worked at a slower speed, with less accommodation for passengers and goods, but capable of carrying the main-line rolling stock, but not the main-line engines. In Britain, with our standard gauge of 4 ft. 8½ ins. and 90-lb. rails, worked at a speed of 55 miles per hour, a light railway is one with 50-lb. rails, on the same gauge, and worked at a maintained speed for passenger trains of say 25 miles per hour. In South Africa, with a standard gauge of 3 ft. 6 ins. and 60-lb. rails, worked at a maintained speed of 23 miles per hour, a light railway is one with 45-lb. rails, and worked at a maintained speed of 15 miles an hour.

What is a light railway in one country becomes a heavy line in another. A narrow-gauge railway is not necessarily a light one, as instance the Festiniog Railway of 1 ft. 11½ ins. gauge, laid with 50-lb.

rails, and the railways in Natal, of 3 ft. 6 ins. gauge, to be relaid with rails weighing 70 lbs. per yard.

In dealing with this subject of light railways, it is necessary to go further than this, and to consider railways laid with rails lighter than what is sufficient to carry the rolling stock of the main lines of a country, and on a narrower gauge, and which may be designated by the term "little" railways, and worked at a less speed than the light railways.

In the development of poor districts, light and little railways are of much more service than the main line. The main line, being of considerable cost, must be taken as straight as the "lie" of the country will allow, between the two objective points, and cannot therefore deviate to the right or left for the purpose of serving an outlying town or moderate-sized village, and the working of the traffic will not allow of frequent stoppages for passengers or goods at small stations; but the local railway for the purpose of securing traffic, and following out the intentions for which it was constructed, can go out of its direct route to serve a large farm or a small village, and the cost will not be greatly enhanced thereby. There are places in England served by the main lines which are eight miles from a railway station, although the farm may be within a short distance of the railway, whilst in the colonies many places are also similarly situated. With local railways as feeders to the main lines, an enterprising farmer might extend the siding right into his homestead, and, by means of a portable railway, convey the trucks to the very spot where he wishes the goods to be taken up. There is no reason why country towns should not lay a branch right down the main street, and every merchant might have a siding right into his store. That this can be more easily done by a "little" railway than by a "light" railway will be obvious to every one from the fact that the rolling stock on the one will be considerably lighter than that on the other, and consequently more easily handled.

One of the most difficult matters to decide in any new country, is the style and class of railway to lay down in a certain district for the traffic that is likely to come upon it. We find many lines in this country and in our colonies in a chronic state of bankruptcy because the works and rolling stock are out of proportion to the traffic, whereas,

had the railway been justly proportioned to the traffic to be carried, it would have earned a fair dividend. A railway is most economically worked when it is fully occupied, and when it is fully occupied it ought to be highly remunerative.

It is much better in the first instance to lay down a light or little railway to develop a poor district, than to lay down a main-line standard. During the years that the district is developing, the railway will be fully equal to the traffic, and when the revenue is such that interest can be paid on increased capital, the permanent way and its rolling stock can be removed to develop another district, and the main-line standard substituted.

In matters of railway construction we must follow the lines that a business man would adopt in opening a store in a new country. He would first build premises suitable to the amount of business he expected to do, or could do, with the capital at his disposal, and as his business increased he would enlarge his premises.

The little railway being first constructed in a district of such a size and weight of rail that it would economically carry the traffic that is likely to pass over it for the first ten years, would be earning a dividend on its small capital, during the greater part, if not the whole, of this time, and when the district had become properly developed by its means, the time would be ripe for replacing it by the heavier rail and rolling stock of the main line. By the very fact of having the little railway running through a district, the main line can be laid down at a cheaper cost afterwards than if it had been constructed in the first instance, and were the work properly organized no hindrance to traffic need take place. By following this method of railway construction in the development of poor districts, a country would possess railways which were always paying their interest on capital, and consequently more districts in a country could have a railway, and no burden would be placed on the finances of a country.

The "little" railway, with its light rolling stock and slow speed, is much cheaper to maintain than a railway with heavy rolling stock, and even if a light line is laid down, using the main-line rolling stock, but running at slow speed, there is always the tendency to increase the speed, and to send over the light railway the heaviest engines of the main line, and the disability, therefore, of constructing

feeders to the main line on a different gauge becomes very often an advantage.

Feeders to the main line in South Australia were constructed on the 5 ft. 3 ins. gauge, with 40-lb. rails, the greatest axle weight was to be 7 tons, and 20-ton engines were to be used, whilst the speed was not to exceed 20 miles an hour. When the line had been opened some time, public pressure was brought to bear on a democratic Government, heavier engines and faster speed were introduced, until at last the engines weighed 9 tons per axle, and the speed increased to 35 miles an hour. The engineer-in-chief, in reporting to the Government, on the opening of the first section, said—

“It must distinctly be borne in mind that the success or otherwise of the economical working of this line will depend upon two principal circumstances: the weight imposed by the rolling stock upon the rails, and the speed of the trains. The weight on any wheel of the engines should not exceed  $3\frac{1}{2}$  tons (or 7 tons per axle), and the speed should be limited to 10 miles an hour for goods, and from 15 to 20 miles an hour for passengers.”

The principle adopted for South Australia was no doubt quite right in trying to find economy of construction in keeping the same gauge, laying a lighter rail, and using lighter engines; but the after events were most serious, and no one can deny that an engine with 9 tons per axle, running 35 miles an hour on a 40-lb. rail, was a condition of affairs that was most dangerous to all concerned. In future railway constructions, constant agitation in Parliament lead to the introduction of the 3 ft. 6 ins. gauge for branch lines into poor districts, and it is admitted that the carrying capacity of this gauge has not yet been reached in that colony, nor is likely to be, for the next thirty years, and it is worthy of note that the working expenses on these railways are less than on the broad gauge.

Scarcely any of the branch lines in New South Wales pay interest on capital after deducting working expenses (some of them do not even pay working expenses), yet the traffic on the majority of them suffices to pay the working expenses of a railway on the main-line standard, and consequently the great desideratum on future branch lines must be to keep down the capital cost. This point has been brought very prominently before the Government by the Commissioners, and they have advocated branch lines of a different type from the main line. In their report for 1894, just to hand, they say—

" We have for some years past urged that for new extensions in a purely pastoral and level country, where the traffic would be exceedingly light, a line capable of carrying a light locomotive, with the ordinary class of rolling stock, at a speed of about 15 miles per hour in daylight only, could be constructed, *exclusive of bridges, waterways, and station accommodation*, which latter should be of the most simple nature, for £1750 per mile. This could only be considered a 'pioneer' railway, and would be altogether different from a standard railway line, even of light construction. It would be simply a line to carry traffic with reasonable speed at a lower scale of charges than is now carried by road. The rates for such lines would bring about a material saving to the users, compared with what is paid for the carriage by road, and the scale of charges should be such as to avoid any material loss to the country. Lines of this character would avoid the great disadvantage of break of gauge; they would cost scarcely anything more in the first instance than a narrow-gauge line; and the whole of the ordinary rolling stock, exclusive of engines, which could be selected from the lightest types existing in the service, could pass over them, and thus avoid the great disadvantage and cost of creating a new class of rolling stock."

The Commissioners recognize that the great desideratum in developing lines is to keep down the capital cost, but the lines they advocate even in a very even country must cost £3000 per mile with bridges and waterways.

But how are the fertile districts to be served which are separated from the main lines by an intervening stretch of difficult country? There is no reason why railways, and especially branch lines, should all be constructed on the same gauge as the main line. The means of transport should be proportioned to the quantities of traffic, and whilst it may be advisable to make a branch line on the main-line standard in one instance, in another it would be well to lay down a light or even a little railway. So impressed with this idea is the Minister of Railways in Victoria that, even against the engineering evidence in the colony, he favours the construction of narrow-gauge railways, and even goes so far as to say that the excessive cost of two shillings per ton for transhipment, is a small price to pay as against the advantages of railways. He goes on further to say that there is no district in that colony where a broad-gauge railway would pay, and the principle the colony must follow in all future railway extensions is to build such lines as will carry the probable traffic.

In the Cape Colony the branch lines there have entailed such an expenditure, that they do not pay the full interest on the capital after deducting working expenses, and, although the whole system yields a return of more than five per cent., the whole of the surplus

money is earned by one line, the Midland, running from Port Elizabeth to the Transvaal Gold Fields. A branch line, constructed and worked by a private company, cannot earn more than 2 per cent., even after the capital has been reduced to about £4700 per mile, with a gross revenue of £297 per mile.

It is therefore necessary for the Colonial Government to take an entirely new departure in the construction and working of future branch lines, and, if they are to be built and worked in such a manner as to pay their way, radical alterations will be necessary in the weight of rail laid down, and in the rolling stock employed.

There is no district in this colony that can support a railway costing even £4,000 per mile, and the utmost limit that a railway should cost, even in the best districts, must not exceed £3,000 per mile, if the revenue derived therefrom is to pay interest on the capital as well as working expenses. There are many fertile districts, with plenty of water, and a good rainfall, and capable of being put under irrigation, which will remain in their present stagnate condition until they can have railway communication to take their produce to the nearest market. Some of these districts are over a hundred miles from that market, and the only means of transport being the bullock-waggon, the farmer is very often six weeks away from home, and never less than three, in taking a waggon-load of produce there. His capital being limited, his means of transport is on the same scale, and he can, therefore, grow on his farm no greater quantity of produce than he can convey to market, yet the farm he holds could be made to produce ten, twenty, perhaps fifty times the quantity.

Under such conditions the country cannot progress agriculturally, and it is not to be wondered at that the Cape Colony is in a worse condition in this respect to-day, than it was fifteen years ago. Were these districts supplied with railway communication, a much larger population could be put upon the land, a larger acreage could be brought under cultivation, and the capital that the farmer has invested in his bullock-waggons and bullocks for transport purposes, would be released for other uses; and, free from transport riding, he would be able to devote more time to his farming operations, to say nothing of the moral and social advantages the district would enjoy by the advent of the railway.

But, in designing a railway for such a district, we have to face the fact that the traffic likely to come upon it at the commencement is of the smallest, that the population is scarce, and that, before the railway—even the smallest possible railway serviceable for steam traction—can have sufficient traffic to pay interest on capital and working expenses, more land will have to be brought into cultivation, the farmer will have to get accustomed to the new condition of things, and the transport rider will have gradually to get rid of his oxen, and settle on the land. The question arises, Is it worth while to give such a district railway communication? Is it possible to lay down a railway to serve such circumstances? Unless the district has railway communication it cannot progress, and we have only to disabuse our minds of the ingrained prejudice we have against break of gauge and "toy" railways, and bring to our aid business principles, when we shall be able, without attempting anything new in railway construction, to build and work such a railway that will have a carrying capacity ample for the district for many years to come.

It may be interesting to show the present poverty of a very fertile district, but one capable of immense possibilities, lying between Port Elizabeth and Uniondale, a distance of about 150 miles.

#### REVENUE.

Say the traffic crossing the Gamtoos River ferry will travel on an

average 120 miles—

							@	£	s.	d.
5612 Tons	...	...	...	...	...	...	40/-	...	11,224	0 0
2925 Passengers 1st Class	...	...	...	...	...	...	40/-	...	5,850	0 0
300 Trucks (Cattle)	...	...	...	...	...	...	60/-	...	900	0 0
40 Trucks (Goats, Sheep, etc.)	...	...	...	...	...	...	60/-	...	120	0 0
1023 Passengers 3rd Class	...	...	...	...	...	...	10/-	...	511	10 0
1000 Holiday Passengers return to Gamtoos River										
(40 miles)	...	...	...	...	...	...	5/-	...	250	0 0

Between Van Staaden's River and Gamtoos River, average distance

say 30 miles—

							@	£	s.	d.
3000 Tons	...	...	...	...	...	...	11/-	...	1,650	0 0
1000 Passengers 1st Class	...	...	...	...	...	...	11/-	...	550	0 0

2000 Passengers 3rd Class	...	...	...	...	...	...	2/9	...	275	0 0
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Between Van Staaden's and Port Elizabeth, average distance 12

miles—

							@	£	s.	d.
1000 Tons	...	...	...	...	...	...	4/-	...	200	0 0
1000 Passengers 1st Class	...	...	...	...	...	...	4/-	...	200	0 0

Carried forward ... 21,730 10 0

				£	s.	d.
Brought forward ...	...	...	...	21,730	10	0
2000 Passengers 3rd Class return, Holiday Traffic (25 miles)	...	...	...	@ 3/-	450	0 0
15,000 Passengers, Suburban (season) to Walmer	...	...	...	1/6	1,125	0 0
Mails and Parcels for 150 miles	...	...	...		1,200	0 0
Estimated total revenue	...	...	...		<u>£24,505</u>	10 0
Total Revenue	...	...	...		24,505	10 0
Allowing 67 % for working expenses on the small traffic	...	...	...		<u>16,405</u>	10 0
Nett revenue	...	...	...		<u>£8,100</u>	0 0
Revenue per mile of Railway	...	...	...		164	0 0
Working Expenses of do.	...	...	...		109	0 0
Nett Revenue	...	...	...		55	0 0
Interest on Capital of £300,000 (150 miles at £2000 per mile)	...	...	...		2 $\frac{3}{4}$	per cent.

Here we see that, if the whole of the traffic passed over the railway, it would pay nearly 3 per cent. on £2000 per mile only, but not much more than one-half would use the railway in the first year (from various causes previously mentioned), but it is safe to predict that in less than five years the railway would pay 4 per cent. in addition to working expenses. In twenty years' time the district would no doubt support a railway of the main-line standard, and had the line been gradually extended towards Cape Town in the mean time, other districts would have been developed, so that the main line could be laid from Port Elizabeth to Cape Town, a distance of about 450 miles, and have a traffic ready developed for it.

It is no argument to say, that because this district is not capable of supporting a light line it shall have no railway at all. We have examples of what can be done by "little" railways in India to guide us in this matter, and so long as a district has fair prospects before it, and when the people of the district are willing to take some of the financial burden on their own shoulders, it is the duty of those who have it in their power, to assist in supplying the pressing needs of such a fertile district. South Australia is even in a worse position, for a railway in the northern portion, running from Port Darwin to Pine Creek, a distance of 145 miles, has a gross revenue of only £16,000 per annum, and a net revenue of £33 per mile, but, constructed at a cost of £7880 per mile, pays only  $\frac{2}{5}$  per cent. on its capital.

Turning from our colonies to this country, we have a few local

railways, notably the Corris Railway, the Southwold, the Easingwold, and one or two others constructed for special purposes, and we have the so-called light railways in Ireland.

As showing what local lines can do for a district, we may take the Southwold Railway, running between Halesworth and Southwold, on the Suffolk coast. This line cost about £8000 per mile (the excessive cost due, perhaps, to financing), and is constructed on a 3-ft. gauge. Before this railway was constructed, an omnibus used to run now and again between the two towns, whereas the railway now carries 90,000 passengers and 9000 tons of goods and minerals annually. In the Easingwold district, an omnibus, running three times a day each way, carried all the traffic, whereas by the railway upwards of 43,000 passengers and 12,500 tons of goods and minerals are conveyed annually. The same statistics might be given of the Corris, the Wisbech and Upwell, and other railways. It cannot be doubted that the traffic has immensely increased through the medium of the railway, and in much greater proportions than if the old carts, waggons, and omnibuses had still been in existence. Turning again to the light railways on the Continent, it will be seen that the increase in traffic after the construction of these railways has been very marked, as instanced by the following lines.

*Ghent-Eecloo-Bruges.*—From 1861-1868 goods receipts grew slowly but regularly from £10 to £147 per mile. The latter figure is practically that of the normal receipts for the following 14 years (1868-1882), when the average was £154 per mile. From 1882 to 1892 the average was £192 per mile.

*Antwerp-Ghent.*—From 1847 to 1857 the goods receipts rose very slowly from £42 to £288 per mile.

*Liège Maestricht.*—From 1862 to 1872 the goods receipts grew from £169 to £824 per mile, that is, about 10 per cent. per mile per annum.

In 1887 the gross receipts per mile reached £960, that is, during the following 15 years, an annual increase of 1 per cent. per mile.

*Termonde-Saint-Nicolas.*—In 1877 goods receipts £80 per mile. In 1883 it had increased by gradual leaps to £242 per mile. From 1883 to 1892 the average remained at £243 per mile.

*Malines-Terneuzen.*—In 1872 the goods mileage receipts were

£192. In 1884, £448 per mile, which is approaching the normal. In 1892, in fact, the goods mileage receipts were £512 per mile.

The light railways in Ireland have greatly benefited the districts they serve both socially and commercially, but they have been constructed at such a cost, that they are not financially successful in themselves, though contributing to the general prosperity of the country. Their construction has been on too elaborate a scale for them to be classed as light railways, under the category of local railways we are now considering, and their working is too similar to that of the main lines to allow of their being economically worked and maintained, and for the relief of agriculture we must look to something more simple than the light railways of Ireland.

If we have not done much in this country for the benefit of agriculture, by providing cheap transport from the main lines, or from the chief markets to outlying districts, other countries have not followed our example, and perhaps the most successful, as well as the best organized system of local railways is to be found in Belgium. By means of a National Society of Local Railways, guaranteed by the Government, and financed by the Government, the State, the Commune, and by private individuals, and worked by private enterprise, a large mileage of these railways has been constructed and successfully worked, and the tariffs charged are very low. It is the object of these railways to earn only the minimum dividend to make them self-supporting, and to charge the rates accordingly. In many instances, during the summer months, six trains per day or more are run in each direction, and in the winter months never less than four. The objects of the Government in organizing these lines are set forth in a document issued by the Society, from which the following is extracted—

"For years past the spirit of enterprise and progress has directed itself almost exclusively to the extension and improvement of main lines of railway. It is true that the number of roads and canals has been increased, and that their construction has been improved, but there have been no changes, or almost none, in the manner in which traffic is conducted on these lines of communication. Old-fashioned waggons continue to travel on the high-roads, and whereas the price of carriage for long distances has enormously decreased, it costs as much as, if not more than, it did half a century back, to cart a load of wheat.

"It is the function of local railways to improve this state of things. Constructed, as a general rule, on the existing roads, and, in consequence, more economically than main railway lines, operated with the greatest economy, and by means of cheap

rolling stock, they will furnish the people with the means of transporting their products at the lowest possible price. By means of their junctions with the main railway lines, they will render access to them more convenient both for passengers and for goods. They will assist communication from village to village, and from village to the adjacent station. They will call into being new industries, by affording them new outlets for their products. Finally, they will enable the farmer to procure at a cheap rate the fertilizers necessary to enable him to face foreign competition, and by the low cost of carriage, will open to him the markets of his own country, as well as those abroad. For many places, deprived, as it seemed, for all time of railway communication, these light lines will furnish an opportunity unheeded for, and possibly the last, of escaping from their fatal position of isolation."

Austria has also promulgated a Light Railway Act, and the Minister of Commerce, in introducing the measure, said—

"His conviction was that light railways could only be built on a large scale if the cost of construction was kept as low as possible, and was so simple and cheap that the lines would return 3 per cent."

So impressed with the benefits which light railways are expected to bring to the country, an Austrian official railway journal says—

"Where, it may be asked, is the reasonable limit of light-railway construction to stop? Only at a point where there is no cart left running, except upon rails, when the last waggoner has taken service as a railway fireman.

"For a manufacturing centre, or, it may be, only a single factory, which is a dozen miles from the nearest station, will, other things being equal, hardly be able to compete with a rival which avoids this dozen miles of cartage, or with a mill which can load its produce direct, because it has a siding into the yard. Once started, the demand for even more and more light railways, even for the shortest distances, and the smallest village, will press forward resistlessly."

The light railways in France have not been such a success financially as they have been in Belgium, and they are a heavy tax on the public exchequer. Still, in every instance, they contribute largely to the finances of the main lines they join, and, from statistics collected, it has been proved that a branch line joining a main line has increased the receipts of the main line very considerably, and yet, while the branch line only earned 77,500 frs., it contributed traffic to the main line which earned for that body 313,500 frs., and which it would not have earned had not the light railway been in existence.

If light railways are to pay in themselves, without taking into account their contributory value to other systems, they must be constructed on the most economical system possible, and this has not been done in France. Most extravagant prices have been paid for the land, and other expenses have been incurred which should not be

exacted in the case of a local railway, and the agreements made with the working companies have been upon too liberal a scale. Yet, if the same economical system had been followed in France as in Belgium, better results would have accrued.

Every nation on the Continent has interested itself in light railways, and the Prussian Minister of Public Works, in moving the third reading of the Light Railway Law (1892), said—

“Elsewhere the construction and working of similar light railways have proved a blessing to the country. A traveller to-day through North Italy, through Belgium, and through Holland can satisfy himself what a blessing these light railways have been. It is as though irrigation canals have been carried through the fields, and everything was growing and flourishing under their fertilizing streams. In North Italy in particular, the blessing which they bring with them is so obvious that even the casual tourist can hardly fail to notice it.”

These expressions of the leading statesmen on the Continent are based on the practical working of thousands of miles of light railways, and one can scarcely understand the position taken up by our own leading engineers and railway managers, whenever the question of light or little railways, or no railways at all, has to be considered for many of the districts in our colonies, and even in this country. Looking at what has been done in other countries for agriculture, by means of light railways, we are right in assuming that, notwithstanding the different circumstances and surroundings of our own people, they would be of equal benefit here, and if they did not benefit agriculture directly, they would indirectly, by elevating the social and moral condition of the country-people, and affording them some inducement to remain in their villages, when the drawback of isolation was removed. It cannot be expected that industries or manufactories can flourish in places removed from railway communication, and here we have another inducement for the construction of these railways into certain districts, and which may encourage capital to be distributed about the country. By means of the lightest of light railways, viz. a little railway, or a steam tramway, the farmer may be induced to cultivate poultry farming and butter making, and so prevent the importation of a large quantity of produce which annually comes into this country from abroad. The farmer is more likely to get a better price for his perishable commodities by being able to send them daily to market, than he does by only sending them once

a week, and when he knows that by despatching them by train daily, they will be on the market within twelve hours, he will be incited to greater exertions, and his mind will be strengthened and invigorated by being in daily contact with the outside world.

It is a favourite argument against the construction of light railways that they do not pay, that the accommodation they give is of the scantiest, and that it is not worth any one's while to interest themselves in the matter. One can only reply that they are not expected to pay handsome dividends, the *raison d'être* of their being constructed as light railways is that the present and near future traffic is not expected to pay a large dividend, but if they pay working expenses, and the interest on their capital, they are doing all that must be expected of them financially. Did they do more, the rates should be reduced to such a point as to wipe off the surplus, and give whatever benefit financially there was to the population of the district. Whether they pay directly or not, however, does not weigh with the Governments on the Continent, as they estimate the indirect gain as greater than the direct loss.

The construction of light railways in this country should not be undertaken in any hap-hazard way, without any regard to their financial position. One of the greatest questions to be decided in projecting any of these lines is its future financial position, and any line projected should have resources to pay, at any rate, for its working expenses in the first year. Some of the light railways in Ireland do not do this, and the best way of securing this object is perhaps by making the people of a district share in the profit or loss of the undertaking.

In our colonies especially should this be the case, and in a proposal made for the financing of a "little" railway in South Africa, the advisability of the people interested, offering to Government to contribute 1 per cent. towards a guarantee required was considered. The railway passed through the districts of five Divisional Councils and one large Municipal Council. Were the proportions of a guarantee to be divided, according to the advantages likely to be gained by each, the burden to be borne by the poorer districts should be lightened by a share of its guarantee being taken up by its rich municipal neighbour, which, being the terminus of the line, would

reap practically the greatest benefit. Each Divisional Council has to maintain its own roads, and, even if a guarantee of 1 per cent. on the cost of construction of the line, had to be paid by all the parties interested, the share of each would not amount to the saving effected in the repair of the roads (always an expensive item in our colonies), by the removal of the heavy traffic therefrom. There are no statistics with reference to this affecting the roads in South Africa, but it must be considerable. In Ireland some of the highway authorities show that the repairs of a road, which cost  $14\frac{1}{2}d.$  per yard before a railway was made, had been reduced to  $3\frac{1}{2}d.$

As has been mentioned before, the construction and working of light railways must be of the cheapest and simplest. In this country, over bridges and under bridges must be dispensed with; level-crossing gates, keepers' lodges, and signals will not be necessary. Except in special cases, fencing must not be required, land must be purchased at its agricultural value, and the working hours of the employees must not be limited to an eight-hours' day. Expensive station buildings and goods sheds must not be erected; the guard must give out the tickets in the train, and all items of working must be reduced to the most rudimentary and economical system.

The restrictions required by the Board of Trade as to interlocking points and signals, as to signals themselves, automatic brakes, and other items, will have to be considerably modified before light railways can hope to have any prospect of being a financial success. The tedious and expensive process of getting Parliamentary sanction for any railway will have to be simplified, and payments made for these services more in accordance with the work to be done.

In this country, where our standard gauge is 4 ft.  $8\frac{1}{2}$  ins., that of each light railway will have to be considered on its own merits, and the gauge best suited for its requirements adopted. It is a favourite argument that the gauge, or the distance between the rails, has the least influence on the cost of a railway, and that it is madness to put down a different gauge from the main line, and so have the expense of transhipping at the junction. This cannot be disputed in the main, but special cases require special treatment, and if a

light railway is to run alongside a country road, or through country villages, a narrower gauge than the main line must perforce be put down. If a light railway is to be worked as a light railway, even if it is the same gauge as the main line, a lighter class of rolling stock should be used, in which the dead weight to the live load shall be better proportioned, and in which each individual truck can be more easily handled at any of the stopping-places or loading-places *en route*. We need only mention the practice of our Continental neighbours, in adopting a metre gauge, to add to our arguments, even on lines that have little length. In our colonies which have adopted the narrow gauge of 3 ft. 6 ins. as their main line, it may be advisable to adopt, in certain districts, a still narrower gauge.

It is more advantageous for the working of a light railway that the rolling stock should be apportioned to the work it has to do, and not be burdened by the comparatively heavy rolling stock of the main line. The rolling stock of these light lines may have to travel over portable lines on a farm, or to a store, and be propelled, in many instances, by hand, or by ponies. It may be difficult to find a load of six tons in one place to fill the truck, and, consequently, a very large dead load, in proportion to the live load, is being hauled for no purpose.

By adopting a special gauge, we show at once that we have departed from the extravagant conditions of the main line, and have taken away the only lever political agitators could have for enforcing higher speeds, better accommodation, and more elaborate working, as instanced in the South Australian light railways constructed on the main-line gauge, and mentioned previously.

If agriculture is to be benefited to any extent by means of light railways in this country, the trucks must run from the field direct to market-places. Lines laid out on this principle will no doubt compete with the main lines; but it cannot be said that at present the main-line companies either care for this traffic or do much to cultivate it. It will be useless for a farmer to support a light line of short length, carrying traffic at a comparatively low rate, if at the junction the traffic is to be handicapped by the excessive rates charged by the main-line companies. To make these lines remunerative, they must have length of haul as well as traffic, they must

pick up traffic as they go along at any point, and must put the producer in direct touch with the consumer without passing through intermediary hands. The lines must be worked by a company distinct from the main line, and by officials who have not been brought up to the red-tape rules and lavish expenditure of the present railways. The men in charge must be able to cut down expenses in every item, to simplify every detail, and to adopt cheap means for gaining cheap ends. The local railways of the country must take the place of the carrier's cart of years gone by; but, in view of their being connected up at some future time, and formed into a secondary railway system, it would be advisable to construct them on one gauge, say 2 ft. 6 ins. or 3 ft., and use rolling stock that could be interchanged.

## CHAPTER II.

*MOST SUITABLE GAUGE AND BREAK OF GAUGE.*

PERHAPS on no detail of railway construction for local railways, or even for opening up new countries by railways, is there so much difference of opinion amongst engineers as on the subject of gauge. It is a common-sense matter after all, and one that can be decided by any one trained to business principles, and with a fair amount of common sense. England, with a larger quantity of traffic per mile of railway than any other country in the world, does her work very well on a gauge of 4 ft. 8½ ins., and we may consider this now as the best gauge that can be put down for all practical purposes for heavy traffic, and though, perhaps, a better gauge to have adopted in the first instance would have been one of 5 ft. 3 ins., still it cannot be denied that our work is done very well on the standard one.

The next gauges of importance are the metre (3 ft. 3½ ins.), and 3 ft. 6 ins., and these have proved very serviceable wherever they have been put down. In poor and mountainous districts they have rendered railway construction financially possible, and profitable, which would otherwise have been impossible with a wider gauge. Wherever the narrow gauge has been put down, its carrying capacity has not yet been reached, and though in many cases in America it has been replaced by the standard gauge, this was considered advisable more to facilitate traffic interchanged, than from any inherent faults of the narrow gauge, and was perfectly justifiable under the increased volume of traffic. The narrow gauge, however, made the standard gauge possible in its district much sooner than would have been the case, had a district waited until it could have furnished sufficient traffic for the standard gauge at first.

Other districts can be named where the standard gauge has been replaced by the narrow gauge, and in considering the two gauges, we must remember that the cost of moving a ton of goods on either gauge is the same, *under similar conditions*, but the interest to be paid on capital is greater in the former than in the latter case.

There are gauges of all widths, constructed in different countries, viz.: 1 ft. 11½ ins., 2 ft. 0 in., 2 ft. 3 ins., 2 ft. 5½ ins., 2 ft. 6 ins., 2 ft. 7½ ins., 2 ft. 9 ins., 3 ft. 0 in., 3 ft. 3½ ins., 3 ft. 6 ins., 4 ft. 0 in., 4 ft. 8½ ins., 5 ft. 3 ins., and 7 ft. 0 in., but for all practical purposes the 4 ft. 8½ ins., 3 ft. 6 ins., and 2 ft. 6 ins. represent the three gauges most suitable for economical railway construction, where steam traction is employed.

The gauge of 2 ft. 6 ins. may be very usefully employed in mountainous districts, or in other places where the traffic is of the scantiest, and where a railway of some kind is necessary to develop traffic and increase the productions of a district, which would otherwise remain stationary, were it not for the railway.

Where railways already exist in a country, and it is desirable to construct feeder or branch lines, which are not likely to be remunerative in themselves, it would be justifiable to run a light line, capable of carrying the main-line rolling stock, but worked with lighter engines, where—

1. The branch line is a short one.
2. A continuation of the main line.
3. On very even ground.

But where the branch line exceeds say 25 miles in length, or has to be constructed in a very rough country, it becomes a question of financial consideration whether it is advisable to construct a cheaper line on a separate gauge, and face the seeming disadvantages of a break of gauge.

The inconvenience of transhipment can be best gauged by the question of expense, which will range from 1½d. to 3d. per ton, and, with the use of modern appliances, can now be done without damage. On some short lines special trucks have been arranged for carrying the main-line trucks over the narrow branch lines, but these have not proved satisfactory in every instance, as it has been found that the loss in work of the main-line truck, during its time on the branch

line, more than counterbalanced the cost of transhipment. A better arrangement for the transhipment of perishable goods, such as fruit, fish, vegetables, etc., or other goods that will not bear much handling, is for the bodies of the branch rolling stock to be made as boxes, and of such a size that two or four of them can fill a main-line truck. The farmer could load these boxes at his farm, bring them to the station on his waggon, load them by cranes on to the branch truck, they would then be transferred to the main-line truck, and finally, if advisable, from the main-line truck to the delivery waggon at the receiving end, and by this method the perishable goods would go from the farm to the market-place without being once handled. The boxes, when empty, could be returned loaded with other commodities, or if empty, could be so packed that one main-line truck would be able to carry several of them.

For the purposes of deciding whether the cost of transhipment would not allow a more expensive line to be constructed, each branch line must be considered on its own merits. Supposing we have a branch line 25 miles long, and we have to tranship 24,000 tons per annum ; this, at 3d. per ton, represents an expenditure of £300 per annum, or £12 per mile, which, capitalized at 3 per cent., means that a further sum of £400 per mile could have been spent on the railway for the purpose of avoiding transhipment ; but this, again, may be more than covered by the reductions that could be made in the cost of construction, and in the running expenses of the lighter line.

If it is a question of having a break of gauge, or no railway at all, the evils of transhipment have not to be considered. A break of gauge occurs wherever produce is handled, as loading from the store to the waggon, and from the waggon to the railway truck ; and why there should be so much outcry against the unloading from one railway truck to another one cannot understand.

The transhipment of traffic from a branch line to the main line can never be a serious matter. Those who make a "bogey" of transhipment should give attention to the remarks of one who perhaps has had to deal with this in far larger proportions than any one previously, or than any one is likely to encounter again. The late Mr. Grierson, General Manager of the Great Western Railway, said—

"The truth was, that some of those who were opposed to a break of gauge, under any circumstances, had very much exaggerated the cost and damages arising from a transfer from one gauge to another. The delay and difficulties arising from a break of gauge were not of a serious nature. With regard to the construction of new lines of railway on a different gauge from that on existing lines, he could quite understand that there would be, and were, cases in every country in which that was a necessity, and even desirable course to adopt, where, from the nature or amount of traffic, the character of the country, or other circumstances, narrow-gauge branches would be sufficient for all commercial purposes, without any serious disadvantages. It would then, and then only, be a question of constructing railways on the narrow gauge, or of having no railways at all; and in such a position he would distinctly say (although it would be a misfortune to be placed in the position of choosing such an alternative), that the railways should be made, notwithstanding that the evil of a break of gauge was incurred."

Sir James Brunlees, President of the Institution of Civil Engineers, said—

"His opinion was that the gauge was a question of circumstances, and that where it would be wisdom in one case to lay a certain gauge, it would be in another the height of folly. As regarded metre-gauge lines, he thought they should be laid out merely as feeders to the railway system of the country, in fact, taking the place of roads. The rails should weigh not more than 30 lbs. to the yard, the engines 8 to 10 tons, and the waggons  $1\frac{1}{4}$  tons empty, with a carrying capacity of 3 tons."

In considering the evils and expense of a break of gauge, much is made by persons, experienced in Government employ, of the necessity of having separate workshops and workmen for the repairs of the rolling stock of the narrow gauge; and this additional establishment must be built and maintained if a different gauge from the main line is decided upon for a branch line. To any one who has had to work railways distinct from the main line, and in an economical manner, this seems a very exaggerated proposition, and will appear so to others when properly considered. On many branch lines one engine, perhaps two, or at most three, will be employed, and even if there were a dozen the ordinary repairs to keep these engines in work would be done by the engine-drivers themselves, assisted by a competent fitter and a blacksmith, as has been done, and as is now done by railway contractors in all parts of the country; and the extensive (?) workshops need only contain a lathe and forge. When it was necessary for an engine to undergo important repairs it would be run on to a special truck—the work of a few minutes—and conveyed over the main line to an established workshop. The ordinary rolling stock would be

treated in the same manner ; but this would not occur to anything like the same extent as with locomotives.

As to the point of providing additional rolling stock, there may be sound argument in this, when an isolated branch line is under consideration ; and this is a point which should be taken notice of when considering the financial cost of the question. There will be times when a short branch line, at busy seasons, might be pressed for rolling stock, and, being isolated, have no opportunity of drawing upon similar lines for a temporary supply. At the same time, it must be remembered that the branch line must be equipped with rolling stock, and if the main line has barely sufficient for its own wants, more must be purchased, and the cost of the main-line rolling stock will be often more than three times the cost of the rolling stock for a branch line, designed for slow speeds, and with a due regard to the proportion of the dead weight to the live load.

No country in the world has taken more advantage of economical means of transport than India, or has made a better adaptation of different types of railway as a means to an end. In that country there is the broad 5 ft. 6. ins. running through the main arteries of traffic, and carrying a large traffic at low rates and at a fair percentage of receipts. Running out of these there are the first-class metre-gauge lines carrying less traffic per mile, but still a very considerable one, and paying a good dividend on the cost of construction. In other places there are second-class metre-gauge lines, serving poorer districts ; and, finally, the special gauges of 2 ft. 6 ins. and 2 ft., serving places where, in some instances, it would be financially impossible to employ any other line.

A railway is simply a machine to serve a definite purpose, and the nearer the machine is apportioned to the work it has to do the cheaper will that work be done, and the better return will there be on the capital outlay. One does not generally employ a waggon and a team of horses to do the work which can easily be done by a costermonger's barrow. Engineers, and especially Government engineers, are so rooted to one gauge, that it is refreshing to find the chief officers of the Bombay, Baroda, and Central Indian Railway advising the construction of a branch line only 22 miles long on the 2 ft. 6 ins. gauge, as there was not sufficient traffic to pay for a 5 ft. 6 ins. railway.

In departing from the normal gauge for the construction of local railways in poor districts (and it is railway construction into these districts that is being considered), the saving in the cost of adopting a different gauge from the main line may be summed up as follows—

1. The saving in cost of construction.
2. The saving in cost of rolling stock.
3. The saving in cost of running expenses and maintenance.

In comparing railways of the same weight of rail, and built for the same speed, and with the same provision for stations, etc., the difference in cost of construction, attributable to the gauge, does not amount to so very much in an easy country for railway construction. By many authorities it is put down as varying between £400 and £1000 per mile. An estimate made in India for a standard, metre, and special gauge railway between certain points 17 miles apart was as under—

Standard gauge 5 ft. 6 ins. ...	...	...	...	£2,927	per mile.
Metre gauge 3 ft. 3 $\frac{3}{8}$ ins. ...	...	...	...	£1969	"
Special gauge 2 ft. 6 ins. ...	...	...	...	£1817	"

And it has been fairly shown that the difference in cost in India, between a 5 ft. 6 ins. and metre-gauge line, comparing like with like, is not under £750 per mile.

Taking the case of a railway in Ireland on the 5 ft. 3 ins. gauge, constructed to carry the main-line rolling stock, and comparing it with the cost of a line on the 3-ft. gauge of *lighter construction*, but still amply sufficient for the estimated traffic, Mr. W. B. Lewis estimates the *saving* on one mile of the single narrow gauge, as follows—

				£	s.	d.
Earthworks	...	...	...	150	10	0
Road approaches	...	...	...	194	4	0
Fencing of do.	...	...	...	16	10	0
Road metal	...	...	...	12	12	0
Ballast and boxing	...	...	...	133	12	0
Public road bridges	...	...	...	211	0	0
Permanent ways rails and fastenings	...	...	...	423	0	0
Sleepers	...	...	...	133	6	8
Carriage of materials and laying	...	...	...	5	16	0
Carried forward	...			1280	10	8

		Brought forward	£	s.	d.
Culverts	...	...	1280	10	8
Accommodation works	...	...	7	10	0
Land	...	...	20	0	0
Proportion of signals	...	...	75	0	0
Stations and platforms	...	...	20	0	0
		100	0	0	
			£1503	0	8
Add contingencies 10 per cent	...	...	150	0	0
			£1653	0	8

The cost of a railway in an *easy* country is influenced by four conditions, and to compare one railway with another, these conditions must be known, viz.—

1. The greatest weight to be carried on one axle, on which the weight of the rail depends.
2. The speed of the trains.
3. The gauge of the railway.
4. The station accommodation.

From which it will be seen that the gauge comes third on the list as influencing the cost of construction in an easy country.

But when we come to consider the cost of construction in a mountainous district, the difference may become very considerable, and amount in some instances to many thousands of pounds. The reduction of the gauge enables curves of very small radii to be used, and whilst a 5 chains radius is as small as it is convenient to go, on the gauge of 4 ft. 8½ ins., a 3 chains radius can be used on the metre gauge, and a 1½ chain on the 2 ft. 6 ins., and the railways will still be in good working condition. The question of curves in laying out a line in a difficult country is one of great importance, as it enables a railway to follow the contour of the ground, to avoid heavy embankments, cuttings and tunnels, and by these means to effect a great saving in first cost. The greater flexibility of the narrow gauge also allows the railway to approach the different large centres of population more readily, and by being able to turn and twist about the streets of a town, to deliver without intermediate transport, at the very doors of the warehouses and market-places, the goods and produce collected in the country.

A table has been published \* which gives very accurately the difference in cost due to the gauge of similar railways, of the same character, constructed through different conditions of country, and serves to show how much can be saved by suiting the gauge to the country to be traversed. But, at the same time, there are various questions to be considered in the solutions of a railway problem, and each proposed line should be considered on its merits.

## COST PER MILE.

Nature of country.	Standard gauge, 4 ft. 8½ ins.	Metre gauge, 3 ft. 3⅓ ins.	2 ft. 6 ins. gauge.
Level .. ..	£ 2,392 to 3,987	£ 1,595 to 2,551	£ 1,260 to 2,057
Slightly undulating ..	3,652 „ 5,582	2,392 „ 3,987	1,595 „ 2,392
Very undulating ..	4,785 „ 7,179	3,652 „ 4,785	2,057 „ 3,190
Slightly hilly ..	6,380 „ 9,571	3,987 „ 5,582	2,392 „ 3,987
Very hilly .. ..	8,742 „ 11,163	4,785 „ 7,178	3,652 „ 5,582
Slightly mountainous ..	10,365 „ 12,760	6,380 „ 8,774	4,785 „ 6,380
Very mountainous ..	11,963 „ 15,950	7,977 „ 11,164	5,183 „ 7,976

In estimating the difference in cost of two gauges in a certain district, it would be necessary to make a separate alignment for each, putting in the curves suitable for each gauge. Where this has been done in one or two cases before deciding upon the type of railway to be put down, the difference in cost has been very remarkable.

For the Denver and Rio Grande, 20 miles in length—

Standard gauge	...	...	£13,952 per mile.
3-ft. gauge	...	...	£3,908 „

For a railway in Queensland—

Standard gauge	...	...	£46,000 per mile.
3 ft. 6 ins. gauge	...	...	£15,000 „

In Queensland, two lines of 6 miles and 16 miles respectively were surveyed, crossing a mountainous district. The curves for the standard gauge (4 ft. 8½ ins.) were fixed at 8 chains radius, and for the narrow gauge at 5 chains. The great difference in cost was due principally to the necessarily larger curves on the one line, whereby the quantity of excavation, the length of tunnelling, the height and length of viaducts, and the length of culverts were considerably increased, causing a difference of £31,000 per mile in construction alone, and adding a considerable annual sum to the cost of maintenance.

\* International Railway Congress.

In adopting a local line on a different gauge from the main line, a considerable saving can be effected in the rolling stock. The rolling stock, not having to intermix with the waggons on the main line, can be of much lighter construction, and consequently cheaper. The waggons on the main line, carrying a load of 10 tons, generally weigh more than 5 tons, having a ratio of live load to dead load of 1.75 to 1; whereas waggons of the same capacity on a narrower gauge can be made, weighing only  $2\frac{1}{2}$  to 3 tons, or a ratio of 3 or 4 to 1. On the broad gauge of 5 ft. 6 ins. it has not been found necessary to make the waggons wider than 8 feet; on the metre gauge there are waggons 8 feet wide, and on the 2 ft. 6 ins. gauge 6 ft. 8 ins. wide.

It is not found in practice, on lines of light traffic, that a greater number of vehicles are required on the narrow gauge to carry the same amount of traffic. The waggons scarcely ever carry their full weight, and this fact gives the light rolling stock an advantage over the heavy stock in reducing working expenses.

Comparing the standard-gauge lines, Beugal-Nagpur (No. 1), and Indian Midland (No. 2), with the metre gauge lines, Bengal North Western (No. 3), and Rajputana Malwa (No. 4), in India, we find that the number of vehicles in a train, with practically the same amount of traffic, differs only in a small degree, which may be attributable to local conditions, and slightly to the advantage of the narrow gauge.

	GAUGE.			
	No. 1, 5 ft. 6 ins.	No. 2, 5 ft. 6 ins.	No. 3, 3 ft. 3 $\frac{1}{2}$ ins.	No. 4, 3 ft. 3 $\frac{1}{2}$ ins.
Average number of passengers in a passenger train .. .. ..	260	175	248	255
Average distance travelled by a passenger in miles .. .. ..	49	68	35	54
Average number of tons in a goods train .. .. .. ..	110	101	97	100
Average distance in miles hauled of a ton of goods .. .. ..	99	140	127	242
Average number of vehicles in a passenger train .. .. ..	19	11	13	16
Average number of vehicles in a goods train .. .. .. ..	24	28	32	24
Average number of vehicles in a mixed train : Coaches .. .. ..	8	9	12	12
" Goods waggons .. ..	14	13	11	9

The saving in running expenses and maintenance on a narrow-gauge line, provided with light rolling stock, may be divided under the following heads, commencing with the most important—

Maintenance.

Traction and rolling stock.

Administration.

The maintenance of a railway depends so much upon the amount of traffic passing over it, the number of the trains, the curves and gradients, that it is difficult to give any correct comparison between the maintenance of one line and another. The first cost of construction of a narrow gauge is less by the avoidance of heavy cuttings and embankments; the dead load is less in proportion to the live load carried; the weight per axle is less, and the speed is less; it must therefore follow that the cost of maintenance must be less, both in labour and material. The cost of maintenance of the three different gauges in India averages—

Standard.	Metre.	Special.	
8d. £137	6·3d. £67	5·9d. £41	Per train mile. Per mile.

Whilst in Ireland, taking railways with practically the same amount of traffic—

5 ft. 3 in.	All railways.	3 ft. 0 in.	
6·40d. to 15·78d. £77 , , £189	7·08d. £144	3·16d. to 5·07d. £32 , , £65	Per train mile. Per mile.

The maintenance expenses on the narrow gauge would show still more favourable results were the traffic greater.

The traction expenses on a line with light rolling stock must necessarily be less, as the locomotive has less dead weight to haul per ton of paying load. On lines of small traffic the haulage expenses are still further reduced by the smaller waggons being better filled, consequently they are more efficiently used. The administrative expenses should be, of course, independent of the gauge. They are influenced more by the exigencies of the traffic and the style of the management;

but as a rule the public will look over the deficiencies of a narrow-gauge line, and suit themselves to a less luxurious condition of things, which, were the line of the main-line gauge, would flood the General Manager's office with letters of complaint, and the newspapers with columns of pent-up wrath.

Knowing the advantages and the disadvantages of a break of gauge, and how much a line may be expected to cost on a certain gauge, under different conditions, it may be useful to consider what is the most useful gauge for local railways. Notwithstanding the systematic opposition which has to be faced in proposing a break of gauge, it cannot be denied that a gauge differing from the main line, has great advantages from the point of view of economy, and may prove the solution of the difficult problem, for the relief of agriculture, of economical local railways.

The most suitable gauge for local railways may be taken to be the 2 feet, or, preferably, the 2 ft. 6 ins. A railway on this gauge can follow the windings and the turnings of any cart road ; it can be laid without inconvenience on the cess of the main roads ; sufficient power can be developed in the locomotive to enable it to haul any load that the district may reasonably require ; and it has the advantage of being the most economical gauge that can be usefully employed in steam traction. By using this gauge, the farmer can employ a portable line about his farm, on which the waggons can be drawn by horses to the place of loading ; the merchant can do the same in his warehouse, and by this means there need be no transhipment between the places of first loading and final unloading.

The weight of rail should not exceed 30 lbs. per lineal yard, and steel sleepers should be used for the better preserving of the gauge.

On this rail a four-wheel-coupled engine weighing 15 tons in working order, will haul a gross load of 150 tons up a gradient of 1 in 100, or 75 tons up 1 in 50. Engines up to 25 tons can be used on this rail, if necessary, with a hauling capacity of 225 tons up 1 in 100. The former engine will run a passenger train, if necessary, at the rate of 35 miles per hour, and can be fitted with a tender to enable it to run 50 miles without stopping. Full particulars of the locomotives and rolling stock suitable for this line will be found under Chapter III.

Several railways on a gauge of 2 ft., 2 ft. 3 ins., and 2 ft. 6 ins. have been built, and are working satisfactorily, and of these may be mentioned the Festiniog, the North Wales narrow gauge, and the Darjeeling railways on the 2-ft. gauge. The Corris Railway on the 2 ft. 3 ins. gauge, and the Morvi, the Gaekwai's Dabhoi, and the Antofagasta and Bolivia (574 miles long) on the 2 ft. 6 ins. gauge. Details as to construction and working of these railways are given in Chapter X.

If in any new country, or in our colonies, a narrow-gauge line has been laid down to develop a certain district, and after the lapse of ten or twenty years it has become inadequate for the traffic, no difficulty need be experienced in making the line of the main-line standard and gauge; and the work can be done without any interference to the traffic. The Bengal-Nagpur Railway, in India, was converted from the metre gauge to the standard gauge for 145 miles of its length in this way, in the space of twelve months; whilst the Great Western Railway, in England, changed 200 miles of their line from 7 ft. to 4 ft.  $8\frac{1}{2}$  ins. in three days, by stopping all traffic during the work of conversion.

The rolling stock, permanent way, and iron superstructure of the bridges used on the pioneer line will be useful to lay down in another district, to develop that district for the advent of the heavier line. The very fact of having the pioneer line in existence will cheapen the construction of the heavier line, and the extra cost of the heavier line will now have a revenue created for it which will make it immediately remunerative. Were this policy more generally followed, the traffic-producing capabilities of a district would be proved at a minimum of cost, and if they did not come up to expectations, the loss incurred would be of the smallest. Whereas, under the present system, branch lines of the main-line standard have been laid down, and the traffic forthcoming has not been sufficient to pay working expenses. The lines are burdened by a heavy capital cost, which hangs as a millstone round the neck of the constructing company or the colony, and that further construction of branch lines—of which many countries, and especially our colonies, stand so much in need—has thus been prevented.

## CHAPTER III.

## THE SURVEY AND LOCATION OF LIGHT RAILWAYS.

THE survey and economical location of a local railway is almost of the same importance, perhaps of more importance, than the location of a main line. The main line, as a rule, runs between two objective points, and its mission is to get there with the best gradients obtainable, but in the shortest distance, due regard being had to the cost of working eventually. The object of the local line is to develop a district, and to make traffic for itself, and consequently must go, in a certain degree, where that traffic is *en route*, and with the best gradients possible for economical working afterwards. For the purpose of collecting traffic from a town some considerable distance from the straight route, it might be necessary to deviate from the straight route some ten miles or more, and increase the length of the line by three miles by doing so, thus—

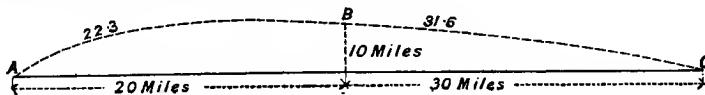


FIG. 1.

The distance AC = 50 miles.  
 " " ABC = 54 miles.

A considerable degree of success of the local line will depend upon its judicious location, and no effort should be spared to effect this by well-trained and experienced individuals.

The position of the line being decided upon, that which should have the next consideration is the gradient. This rules the load an engine can haul, and is a measure of the accommodation afforded by,

and determines the carrying capacity of the line. Whilst no regard in ordinary light lines need be paid to gradients over 1 in 200 for the purpose of cheapening construction, all gradients below this should be considered and calculated on measure of distance. The influence of a gradient on the value of a railway is of very great importance; and in comparing one main line with another, their equivalents in distance has been reckoned as follows. In considering gradients below 1 in 200, one line may practically be considered as good as another, but for gradients between 1 in 200 and 1 in 100, one mile should be reckoned as  $1\frac{1}{5}$  mile, and the following table will show the value of two railways reckoned by the gradients—

Between 1 in 100 and 1 in 66 as $1\frac{2}{3}$ miles.					
“	1 „	66 „	1 „	50 „	$1\frac{3}{5}$ „
“	1 „	50 „	1 „	40 „	$1\frac{1}{3}$ „
“	1 „	40 „	1 „	33 „	2 „
Above	1 „	33 „	...	...	$2\frac{1}{3}$ „

Passenger traffic always follows the route which most suits its convenience, but goods traffic goes by the shortest route, and in dealing with competitive lines, the shortest route for goods traffic can be determined by the above table.

The hauling power of a locomotive is considerably lessened on the steeper gradients, and there are also many difficulties raised by them in the speed of trains, both ascending and descending, and a considerable element of danger in working heavy goods trains.

The table on page 51 will show the power of a locomotive working on different gradients.

It will be seen that the influence of severe gradients has a very material effect on the carrying power of a railway, and, in laying out a line, it may be policy to follow that route which affords the easiest possible gradients for the longest distance, and cross over the intervening distances with such gradients as are found necessary.

If it is in any way practicable to locate the line that the steepest gradients can be in one district of 30 miles or so, this district could be worked by special engines, either of heavier type, or of special construction. The weight of rails and curves could be compensated for this, and the extra cost of construction for this portion,

if any, may be allowable by the saving effected in working expenses over the whole line.

It has been estimated as under for two lines of railway between two points 80 miles apart, point to point, one with a gradient of 1 in 30, and the other 1 in 15.\*

	Ordinary light system.	Proposed light system.
Length of line .. .. ..	135 miles	93 miles
Maximum gradient .. .. ..	1 in 30	1 in 15
Weight of engine .. .. ..	24 tons	40 tons
" of rails .. .. ..	40 lbs.	32 lbs.
" of adhesion .. .. ..	19 tons	40 tons
Maximum load up, 1 in 30 .. .. ..	61 "	148 "
" 1 in 15 .. .. ..	9 "	61 $\frac{1}{3}$ "
Cost per mile .. .. ..	£5896	£4268
Total capital .. .. ..	£794,780	£394,363
Working expenses .. .. ..	£38,880	£31,758
Train miles .. .. ..	260,164 miles	187,303 miles
Receipts .. .. ..	£56,000	£56,000
Interest on capital .. .. ..	2 $\frac{1}{2}$ per cent.	6 $\frac{1}{3}$ per cent.

With a traffic of 60 tons of goods per day, and one passenger train in each direction, and rates charged at 2*d.* per ton per mile for goods traffic, and 1*d.* per mile for passengers.

It should be particularly borne in mind that, because a 1 in 40 gradient has been found necessary in one particular place, the same gradient can with impunity be laid out in other places. The best gradients that can be obtained must be used—of course with due regard to the cost of construction in each particular section of the line. There is an instance in one of our colonies where, because 1 in 40 was adopted as the ruling gradient, the engineer, in staking out the line, put in this gradient without taking the trouble to see whether better gradients could be obtained at certain places. In after years, when the traffic of the line considerably increased, and competition from another line was an element of danger, it was decided to reduce the gradients on certain sections to 1 in 80; and, in surveying for these reduced gradients, it was found, in one instance, that the 1 in 80 gradients shortened the distance between the two respective points, and, had this gradient been adopted in the first

instance at this particular place, the original cost of construction would also have been reduced.

A ruling gradient of 1 in 80 is, perhaps, the best gradient that can be obtained in many countries, and steeper gradients than this, for any considerable length, should not be put in unless for the purpose of avoiding heavy earthworks or bridges. Where it is absolutely necessary to use steeper gradients at successive points to overcome sharp rises, the gradients may be so arranged that they will not interfere with the hauling capacity of the locomotive.

The light lines in Prussia, on the 2-ft. gauge, used for both passenger and goods traffic, have a ruling gradient of 1 in 50; but, when gradients between 1 in 40 and 50 are introduced, if longer than 500 yards, a horizontal stretch of double the length of the gradient is arranged before it, so as to allow the train to store momentum for the ascent. Steeper gradients also up to 1 in 25, if they do not exceed 120 yards long, and 1 in 30, not exceeding 220 yards long, can also be overcome by the tractive power generated, and without additional locomotives; and still steeper gradients of 1 in 18 can be negotiated, if such gradients do not exceed the length of the train.

From what has been written, it will be seen that the question of gradients is one of great importance, and its importance may be carried a step further if the light line has any probability of being converted into a main line at some future period.

The conversion of the light line to one of heavier construction, necessitates the widening of cuttings and embankments, if on a wider gauge, and, may be, the flattening of curves. It will be seen that, if the light line has been laid to the best gradients obtainable in the first instance, the conversion of the line can take place on the same track, and at the least possible cost.

Every latitude must be allowed in the laying out of a line in the matter of curves, and, when the minimum radius has been decided upon, it can be introduced, and must of necessity be introduced, wherever a saving in cost of construction can be effected.

In laying out a curve on the ruling gradient, the gradient for this particular distance must be compensated to suit the radius of the curve, so as not to increase the resistance to the locomotives

more than on the ruling gradient. The compensation generally allowed is 0·05 per cent. of gradient for each degree of curvature. A gradient of 1 per cent. is 1 in 100, and a degree of curvature is 5730 feet radius.

There will be no occasion to consider the future conversion of the line in the matter of curves, as the first cost being a consideration, it is absolutely necessary to introduce sharp curves. When it becomes necessary to convert the line, the traffic on the line must be such that the extra expenditure in flattening the original curves for the new line will be justifiable, or the necessity for converting the line would not have arisen. No obstruction or delay to traffic will occur, and little expenditure will have been wasted in the original trace.

The minimum radius of curves generally adopted on a 3 ft. 6 ins. gauge is one of 5 chains, and this is the radius which experience has proved to be the smallest that can practically be used on open lines for ordinary speeds, though curves of 3 chains radius are freely used in station yards and sidings. The corresponding curve on a 4 ft.  $8\frac{1}{2}$  ins. gauge open line would be 8 chains radius; but, when dealing with a gauge of 2 ft. 6 ins., the curve would only be  $1\frac{1}{2}$  chain radius.

The following diagram will show, to the non-professional mind, in a graphic manner the saving to be effected in earthworks and bridges, viaducts or tunnels, and afterwards in maintenance expenses, by being able to follow the contour of the ground in a mountainous country by using sharp curves.

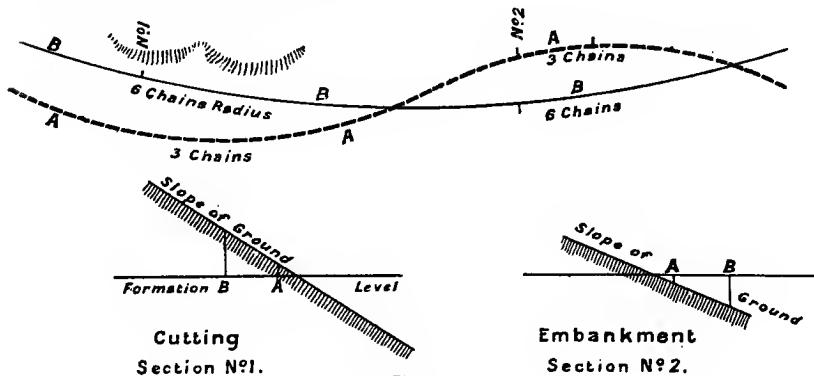


FIG. 2.

## CHAPTER IV.

*THE PERMANENT WAY.*

IN designing a local railway, and deciding upon the type of line proposed to be laid down for serving a particular district, it is necessary to fix, in the first instance, the weight per lineal yard of the rail to be used. On this depends the character of the line in a great measure : the ballast, the sleepers, the bridges and viaducts, the maintenance of the line, the weight per axle of the engine and rolling stock, and the capability of the line for carrying either a heavy or a fast traffic.

The chief item in the construction of cheap railways that is generally fixed upon for economy is the weight of the rails, and this is so for the reason stated above, and also because the permanent way is the largest individual item of cost in a light line. It is of the utmost importance that the rail should be amply sufficient to carry the rolling stock and traffic that is likely to come upon the road ; and of economies practised, and which must necessarily be practised, in the construction of local railways, the worst economy is that of cutting down the weight of the rail to the lowest possible limit.

There are ample opportunities to the efficient engineer to effect economies other than in the rail, and where such economies can have very little harm either in the future capability of the line, for carrying traffic, or in increasing the cost of maintenance. Stations and station buildings, earthworks, masonry, culverts, bridges, signals, and management, are all legitimate items for economy, which may be cut down to a very considerable extent from the standard adopted on the main lines, without in any way interfering with the earning capacity of the line.

If it is decided to construct a local line capable of conveying the rolling stock of the main lines, but not the engines, it will be necessary, in many instances, to use a rail of 50 lbs. weight per lineal yard, whereas if the line is to be extended into poor districts, and a break of gauge is decided upon, a rail of 30 lbs. weight can be used. Rails

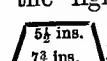
of a lighter weight than this have been used for locomotive traction but for practical purposes, and for the lines under consideration, a rail of 30 lbs. weight is the lowest weight economically justifiable for local railways for steam traction.

Even for a roadway that has little more than the traffic going along the ordinary turnpike road, it is advisable to effect the economies necessary in the works below formation level, rather than to cut down to the lowest possible limit the weight of the rail. The weight per axle that a rail of a certain weight will carry depends upon the spacing of the sleepers and the quantity and quality of the ballast. The usual practice in India has been to allow, with 2000 sleepers per mile, 8 tons per axle for a 40-lb. rail, and 10 tons per axle for a 50-lb. rail; whilst in other places a much less axle weight has been followed.

A rough-and-ready rule for calculating the weight per axle that rails up to 45 lbs. per yard will carry, is to allow 6 lbs. per yard of rail, for every ton weight on an axle. Experience has shown that 7 tons per axle is a sufficient load for a  $41\frac{1}{4}$ -lb. rail to carry for economical maintenance, with 1920 sleepers to the mile, and 6 ins. depth of ballast under the sleepers.

The sleepers to be used will depend upon the facility the country affords for supplying them, but if the difference in cost is not considerable, steel sleepers are to be preferred to wooden ones. The life of a steel sleeper may be taken at from four times that of a wooden one, and it has the additional advantage of keeping the road in better gauge when light rails are used, and forming altogether a firmer permanent way.

They should have the clips punched out of the solid, and the rail fastened with a jagged steel key. On the straight portions of the railway, the key would be placed on the outside of the rail, and on curves, on the inside of one or both rails, according to the allowance of extra width of gauge required by the radius of the curve. If wooden sleepers are used, they can be either square or half-round, and should be creosoted if possible, and thoroughly dried and seasoned before being used.

On the light railways in Hungary the sleepers are of this section  , and the rails rest on a sole-plate on the sleeper.

This is a very good form for a sleeper with a flat-bottom rail, as it has a good wide base, and the rail, having a shorter bearing on the sleeper, is not so liable to cause the sleeper to rock on the passing of the rolling load. Spikes or coach-screws may be used for fastening the sole-plates to the sleepers, and wherever possible, the sole-plates should be fastened to the sleepers before the latter are distributed for laying. It is also advisable for the sleeper to be bored for the spikes before creosoting, as by so doing the creosote penetrates into the timber surrounding the spike, and the timber is thus prevented from prematurely decaying at the spike holes.

The switches and crossings should be riveted to iron sole-plates, so as to ensure them keeping their respective positions. Being of light material, they are more liable to shift, and are not so easily kept in their place as the heavier material used on main lines.

The ballast should be of the best description obtainable, and as a small quantity per lineal yard is used, it would not cost much, if it were screened before being put in position. This would ensure better drainage in wet weather, and would also prevent the clogging of the axle-boxes with fine dust. The permanent way also must be of the best description of its kind, as on this depends, in a great measure, the annual cost of maintenance.

The following table gives the cost for the permanent way of four probable light lines, including laying and ballasting, each line apportioned to the weight carried per axle, and to a speed of 10 to 20 miles per hour—

Railway No. 1	...	...	20-lb. rails	...	...	2 ft. 0 ins. gauge.
”	2	..	25	”	...	2 ft. 6 ins. ”
”	3	..	30	”	...	2 ft. 6 ins. ”
”	4	..	50	”	...	Metre or 3 ft. 6 ins. ditto.

#### PERMANENT WAY.

The *rails* in use on different railways vary only as to size and weight; steel is now universally used. A rail of 36 lbs. per yard on the 2-ft. gauge,  $41\frac{1}{4}$  lbs. on the 2 ft. 6 ins. gauge, and 60 lbs. on the metre or 3 ft. 6 ins. gauge, is the heaviest that should be used for ordinary work.

The *fish-plates* are generally plain, and vary in size and weight according to the rail; sometimes they are angular.

**Steel Sleepers** (Indian States Railway pattern).—As will be seen

from the following illustration of this sleeper, the metal is rolled thicker on the top than on sides, the sleeper being afterwards pressed to form

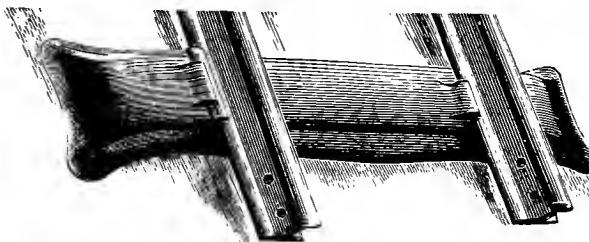


FIG. 3.

by hydraulic pressure, and the clips punched out at top, and bent to fit rails. The rails are held in position by steel wedges, one end of which is split. When extra width of gauge is required for curves, etc., this may be easily obtained by fixing the wedges at inside of rails.

Gauge.	Approximate weight of sleeper.	Length of sleepers.	Price, complete with wedges.	Suitable for rails.
ft. ins. 2 6	lbs. 35	ft. ins. 4 6	£ s. d. 0 2 10½	lbs. per yard. 25 to 30
Metre	65	5 4	0 4 3	40 , 60
3 6	67	5 6	0 4 4½	40 , 60

## FISH-BOLTS AND SPIKES.

		WEIGHT OF RAIL PER YARD.			
		No. 1. 20 lbs.	No. 2. 25 lbs.	No. 3. 30 lbs.	No. 4. 50 lbs.
Size of bolt	.. ..	ins. in. $2\frac{1}{4} \times \frac{1}{2}$	ins. in. $2\frac{5}{3} \times \frac{5}{8}$	ins. in. $2\frac{5}{3} \times \frac{5}{8}$	ins. in. $4\frac{1}{2} \times \frac{5}{8}$
Spikes	.. ..	4 $\times \frac{1}{2}$	$4\frac{1}{2} \times \frac{1}{2}$	$4\frac{1}{2} \times \frac{1}{2}$	$5\frac{1}{2} \times \frac{1}{2}$

*Bed-plates* are flat pieces of iron interposed between the rails and sleeper to give the rail a greater bearing, and are absolutely necessary when wooden sleepers are used. A raised rim on the other edge is an improvement on the otherwise plain plate.

Size of bed-plate	..	ins. in. in. $5 \times 4 \times \frac{3}{16}$	ins. in. in. $5 \times 4 \times \frac{1}{4}$	ins. in. in. $5 \times 5 \times \frac{1}{4}$	ins. in. in. $7 \times 6 \times \frac{1}{2}$

Sleepers, wood.			2000 per mile.			Weight per mile.	Weight each.
		Gauge. ft. ins.	ft. ins. ins. ins.			tons	lbs.
Railway No. 1	..	2 0	4 0 × 6 × 4			22	25
„	2	.. 2 6	5 0 × 6 × 4			27	30
„	3	.. 2 6	5 0 × 6 × 4			27	30
„	4	.. 3 3 $\frac{3}{8}$	6 3 × 8 × 5			58	66

Steel, with keys.			Plain trough.	Weight per mile.	Weight each.
		Gauge. ft. ins.	ft. ins. ins. ins.	tons	lbs.
Railway No. 1	..	2 0	4 0 × 6 × $\frac{1}{4}$	18	20
„	2	.. 2 6	5 0 × 6 × $\frac{1}{4}$	22	25
„	3	.. 2 6	5 0 × 6 $\frac{3}{4}$ × $\frac{1}{4}$	27	30
„	4	.. 3 3 $\frac{3}{8}$	5 9 × 12 × $\frac{1}{4}$	60 $\frac{1}{4}$	70

Steel, with keys.			Corrugated.	Weight per mile.	Weight each.
		Gauge. ft. ins.	ft. ins. ins. ins.	tons	lbs.
Railway No. 1	..	2 0	4 0 × 6 × $\frac{3}{16}$	16	18
„	3	.. 2 6	5 0 × 6 $\frac{3}{4}$ × $\frac{3}{16}$	35	39

## POINTS AND CROSSINGS, RIVETED TO WROUGHT-IRON BASE-PLATES.

	RAILS PER YARD.			
	20 lbs.	25 lbs.	30 lbs.	50 lbs.
	<i>£ s. d.</i>	<i>£ s. d.</i>	<i>£ s. d.</i>	<i>£ s. d.</i>
Two-switch and crossing	5 15 0	6 15 0	7 5 0	16 0 0
Single crossover ..	11 15 0	14 0 0	15 0 0	32 0 0

## TOTAL WEIGHT OF PERMANENT WAY PER MILE.

RAILS PER YARD, AND GAUGE OF RAILWAY.						
	No. 1. 20 lbs. 2 ft. 0 ins.	No. 2. 25 lbs. 2 ft. 6 ins.	No. 3. 30 lbs. 2 ft. 6 ins.	No. 4. 50 lbs. 3 ft. 3 $\frac{1}{2}$ ins., or 3 ft. 6 ins.	tons	cwts. qrs.
Rails .. .. ..	31 9 0	39 5 0	47 3 0	78 10 0		
Fish-plates .. .. ..	0 17 2	1 2 3	1 7 0	4 15 0		
Fish-bolts .. .. ..	0 5 0	0 9 0	0 9 0	0 12 0		
Spikes .. .. ..	1 4 3	1 6 0	1 6 0	2 8 0		
Bed-plates .. .. ..	2 0 0	3 0 0	4 0 0	11 6 0		
Sleepers, wood .. .. ..	22 0 0	27 0 0	27 0 0	58 10 0		
,, steel .. .. ..	18 0 0	22 0 0	27 0 0	62 10 0		
Total weight, with wood sleepers	57 16 1	72 2 3	81 5 0	156 1 0		
,,    ,,    steel    ,,	50 11 2	62 16 3	75 19 0	146 7 0		

## BALLAST.

Railway No.	Rails.	ft. ins.    ft. ins.    ft. ins.
1      20-lb.	5 0 x 3 0 x 0 6 = 0.36	cubic yd. per lin. yd.
2 & 3    25 & 30-lb.	6 0 x 3 0 x 0 9 = 0.50	,,    ,,,
4      50-lb.	8 0 x 3 0 x 1 0 = 0.89	,,    ,,,

TABLE A.

## PROBABLE COST OF THE PERMANENT WAY, LAID AND BALLASTED, IN THE UNITED KINGDOM.

	WEIGHT OF RAIL PER LINEAL YARD, AND GAUGE OF RAILWAY.											
	20 lbs. 2 ft. 0 ins.			25 lbs. 2 ft. 6 ins.			30 lbs. 2 ft. 6 ins.			50 lbs. 3 ft. 3½ ins.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Rails, at £4 10s. per ton ..	141	15	0	176	12	6	212	3	6	353	5	0
Fastenings, at £15 per ton ..	16	17	6	23	5	0	27	0	0	80	5	0
Steel sleepers, at £8 ..	144	0	0	176	0	0	216	0	0	500	0	0
Add 10 per cent. for points, crossings, and sidings ..	30	5	3	37	11	9	45	10	4	93	7	0
Cost of materials .. ..	332	17	9	413	9	3	500	13	10	1026	17	0
Loading and distributing materials along line, at 2s. 6d. per ton .. ..	6	17	6	7	15	2	9	10	0	18	5	0
Laying road and lifting, at 9d. per lineal yard .. ..	66	0	0	—	—	—	—	—	—	—	—	—
1s. .. ..	—	—	—	88	0	0	88	0	0	—	—	—
1s. 3d. .. ..	—	—	—	—	—	—	—	—	—	110	0	0
Ballasting, at 2s. 6d. per cubic yard .. ..	80	0	0	110	0	0	110	0	0	198	0	0
Add 10 per cent. for points, crossings, and sidings ..	15	5	9	20	11	6	20	15	0	32	12	6
Cost of laying, etc. .. ..	168	3	3	226	6	8	228	5	0	358	17	6
Cost of materials .. ..	332	17	9	413	9	3	500	13	10	1026	17	0
Cost of laying .. ..	168	3	3	226	6	8	228	5	0	358	17	6
Total cost per mile .. ..	£501	1	0	£639	15	11	£728	18	10	£1385	14	6

If constructed in one of our colonies, the cost may amount to:—

TABLE B.

	WEIGHT OF RAIL PER LINEAL YARD, AND GAUGE OF RAILWAY.											
	20 lbs. 2 ft. 0 ins.			25 lbs. 2 ft. 6 ins.			30 lbs. 2 ft. 6 ins.			50 lbs. 3 ft. 3½ ins.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Materials f. o. b. England ..	332	17	9	413	9	3	500	13	10	1026	17	0
Freight and landing, at 25s. per ton .. .. ..	63	15	0	78	15	0	95	0	0	183	2	6
Duty free—add points and crossings .. .. ..	6	7	6	7	17	6	9	10	0	18	6	3
Cost of materials landed ..	403	0	3	500	1	9	605	3	10	1228	5	9
Loading, conveying, and distributing materials along line, say at 20s. per ton ..	51	0	0	63	0	0	76	0	0	147	0	0
Laying road and lifting, at 20 per cent. on English prices	79	4	0	105	12	0	105	12	0	132	0	0
Ballasting, at 20 per cent. extra to English prices ..	96	0	0	132	0	0	132	0	0	237	12	0
Add 10 per cent. for points, crossings, and sidings ..	22	12	4	30	1	2	31	7	2	51	13	2
Cost of laying, etc. .. ..	248	16	4	330	13	2	344	19	2	568	5	2
Cost of materials landed ..	403	0	3	500	1	9	605	3	10	1228	5	9
Cost of laying, etc. .. ..	248	16	4	330	13	2	344	19	2	568	5	2
Total cost in a colony (probable) per mile .. ..	£651	16	7	£830	14	11	£950	3	0	£1796	10	11

## CHAPTER V.

*BRIDGES AND CULVERTS.*

IT may be economy in the first instance to construct the bridges for local lines of timber, if procurable in the country, so as to lessen the first cost. Timber bridges will last for twenty years, and when it becomes necessary to renew them, the line may be in such a position financially that this can be done out of revenue, or, at any rate, out of a sinking fund provided for this purpose. If stone is plentiful in the district, the abutments may be of dry rubble or concrete, with timber tops or rolled joists, as may be found convenient. The abutments and piers must be built of sufficient strength to support the thrusts imposed upon them, irrespective of the gauge or the rolling load; but the superstructure, when of iron or timber, may be made according to the rolling load first determined upon. First cost is a consideration in constructing local lines, and if the character of the line is not likely to be altered for the space of twenty years, it is a waste of money to pay for extra iron, however small, in the superstructure, until the standard of the line is changed.

It may be also more economical in certain places to use timber tressels, where the railway runs for a considerable distance above the original surface of the ground, say at a height of 10 or 15 ft., instead of making an earthen embankment. These are details that can be decided on the spot by the engineer in charge of the construction, and much will depend on the resources of the engineer, whether the line is economically constructed or not.

In crossing rivers of considerable width, as are met with in our colonies, with the bed of the stream between high surrounding banks, and which are subject to high floods, rising and falling rapidly, at

certain periods of the year, it may be advisable to approach the river with 1 in 80 gradients, and run across the bed of the river on a masonry or concrete wall, say 6 ft. high, rather than build an expensive bridge several feet above the highest known flood, with deep foundations.

Communications may be interrupted for three or perhaps four days at a time twice a year, but this would not be of so much importance as the saving of several thousands of pounds. The concrete wall would answer the purpose of a dam which may serve for irrigation purposes, or the watering of cattle. Self-acting sluices, or other arrangements, would be necessary to prevent communications being interrupted by every slight freshet, and which would also allow free passage of the water in the main channel at the time of heavy flood.

Wrought-iron pipes, earthenware pipes, wooden boxes, or tressel work might take the place of culverts in small and large water-ways in the first instance, as would be found most economical, and in tropical countries it would be better to repair washaways, rather than anticipate them by extensive precautions years before they would be called into use. The interruption of communications now and again would not be a serious matter on a local line, and might conveniently be risked, if considerable sums of money would be saved thereby. In calculating the strength for the superstructure of bridges, a rolling load of 15 cwt. per lineal foot may be taken for rails up to 30 lbs. per lineal yard for spans of 20, 40, and up to 60 feet, whilst for heavier rails the weight adopted on the Indian metre-gauge railways may be used.

Span.	Rolling load.		Weight of iron in bridge.	
ft.	tons		tons	cwts.
20	20		2	5
30	30		5	0
40	40		7	0
50	50		11	0
70	62	Load on bottom	22	0
150	110	” top	14	0
			72	0

The weights under the Board of Trade requirements for this country are nearly double the above.

**Steel Bridge.**—A light lattice steel-girder bridge, suitable for

carrying a light railway over a valley or river, is shown in Fig. 4. The approximate prices and weights for several spans, suitable for carrying railways of 30-in. to metre gauge, with rails 30 to 36 lbs. per yard, and locomotives weighing 18 tons, with corresponding rolling stock, are—

Span.	Approximate weight.	Price.
ft. ft.	tons	£
60 × 13 wide	20	250
80 × 13 "	28	325
100 × 13 "	47	450
120 × 13 "	55	650
160 × 13 "	95	1050

The above prices include construction, erection, painting, taking down, packing, re-marking for re-erection at destination, and delivery f. o. b. export steamer.

The approximate weight of iron in the superstructure of bridges, suitable for light railways, and capable of carrying a locomotive weighing 20 tons and a train, may be given as under, fixed complete :—

Span.	Approximate weight.	Per ton.	Cost.	Per lineal foot.
ft.	tons	£	£	£ s. d.
20	2·5	12	30	1 10 0
30	5·0	"	60	2 0 0
40	7·0	"	84	2 2 0
50	11·0	"	132	2 13 0
60	18·0	"	216	3 12 8
70	22·0 load on bottom			
70	14·0 load on top }	"	168	2 5 9
80	28·0	"	336	4 4 0
100	47·0	"	564	5 12 9
120	55·0	"	660	5 10 0
160	95·0	"	1140	7 2 6

In New Zealand, timber bridges\* were erected as under :—

Greatest height.	Length.	Area in 100 sq. ft.	Total cost.	Cost per 100 sq. ft.	Cost per lineal ft.
ft.	ft.	ft.	£	£	£
89	484	267	5799	21·71	11·98
86	606	356	8412	23·63	13·86
76	224	106	3049	28·75	13·60

In South Australia,† a 60-ft. span, capable of carrying a load of

\* *Min. Proc. Inst. C.E.*, vol. lxiii. p. 60.

† *Ibid.*, vol. lvi. p. 36.

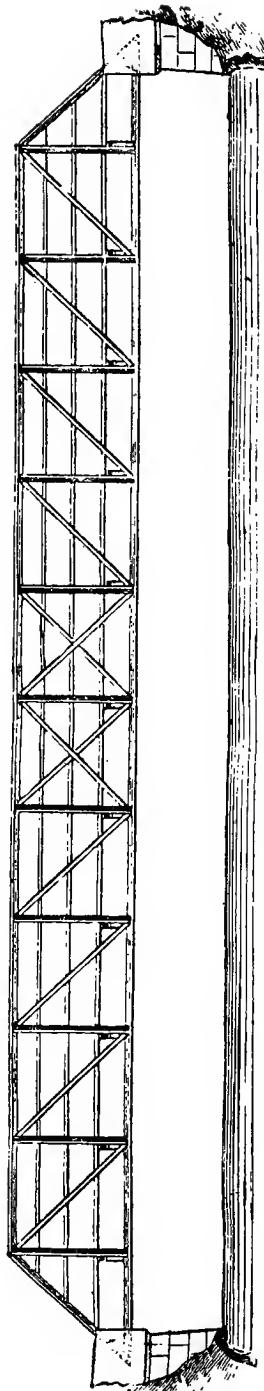


FIG. 4.

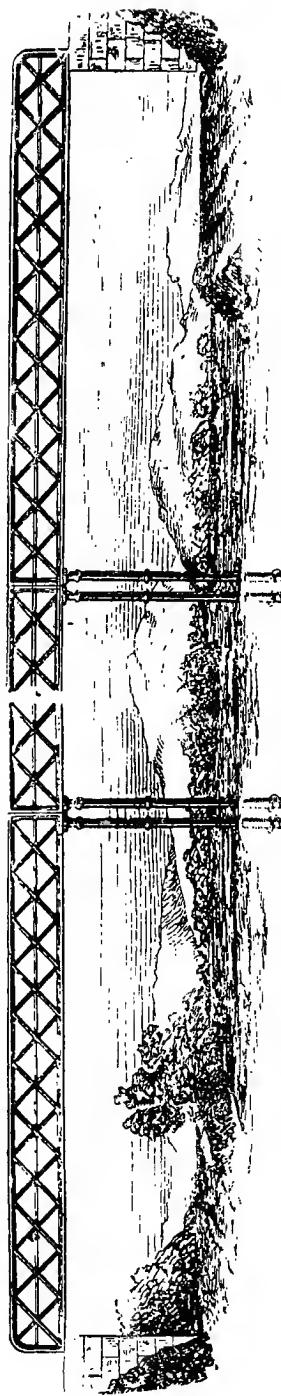


FIG. 5.

Type of lattice-girder bridge, arranged with screw-pile supports for bridging large spans at economical cost.

15 cwt. per lineal foot, with the load on the top of the girders, has been built as under.

With limited headway, plate girders are used 4 ft. 6 ins. deep, and in all other cases lattice girders 6 ft. deep. The girders are spaced 5 ft. apart, centre to centre, braced together with vertical cross bracing, and stiffened by horizontal sway bracing. The girders are fixed on screw piles 21 ins. diameter, spaced 10 ft. apart, centre to centre, and braced together.

The total weight of wrought iron in a bridge of 60-ft. span was as follows:—

	tons cwt. ..	tons cwt. ..	£ s. d.
Two plate girders, etc. .. ..	9 12½		
Two lattice girders .. ..	—	8 2½	
Cross-head girder .. ..	18½	18½	at £12 per ton = 108 12 0
Cast iron in screw piles, 2 piles per span, 20 ft. above ground and 10 ft. below .. ..	7 0	7 0	at £6 , , 42 0 0
			£150 12 0
Total iron in a plate-girder span .. ..	17 11	—	or £2 10s. 0d. per lineal ft.
“ lattice-girder span	—	16 1	

To this must be added the timber flooring and hand railing.

In Sumatra, for 35-ton engines, having an axle weight of 9 tons, the weight of iron in the superstructure of bridges for the different spans is as under:—

Clear span between abutments.	Railway on top flange.	Railway between girders.
ft. ins.	tons	tons
6 7	0.35	—
10 2	0.87	—
19 8	2.40	—
23 8	2.46	—
26 3	4.05	6.80
32 9	5.75	—
39 4	—	11.21
49 3	15.00	11.38
65 3	16.95	21.02
82 0	—	26.79
98 2	—	40.01
130 11	—	58.66
163 7	—	83.05
183 9 arch	—	122.02

The following bridges\* have been erected in India, on the Rajputana State Railway, metre gauge, and 50-lb. steel rails:—

\* *Min. Proc. Inst. C.E.*, vol. 1. p. 154.

Name of river.	No. of openings.	Clear span of each opening.	Height of under side of girder to above bed of stream.	Cost per lineal foot, including abutments and piers.
Pempura ..	3	40	23	£ s. d. 14 14 0
Pailara ..	4	60	15	25 10 0
Amanishah ..	4	142	48	48 14 0
Datra ..	8	20	16	12 11 0
Ranowlee ..	30	10 $\frac{1}{2}$	13 $\frac{1}{2}$	7 15 0
Jataoli Sabi ..	130	22	10	11 11 0

On railways in the Cape Colony, bridges have been erected for a 3 ft. 6 ins. gauge railway and 60-lb. rails, including masonry abutments and piers :—

	ft.		£ s. d.
1	200		45 0 0
1	150		40 0 0
1	80		31 0 0
1	70		31 0 0
2	50		30 0 0

The Americans have built tressel work for their railways, 40 feet high, at from £2 to £2 10s. per lineal foot. Timber-trussed bridges, 100 ft. to 150 ft. high, from £5 5s. to £6 15s. per lineal foot, and pin-jointed girder bridges, 100 ft. to 200 ft. span, superstructure only, at £9 per lineal foot.

**Culverts.**—The culverts can be constructed of concrete, masonry, brickwork, timber, or piping, as may be most economical, according to their situation, and have either arches, timber, or rolled joists for covering.

The following table of rolled joists, suitable for a rolling load of 1 ton per lineal foot, may be useful :—

Span in feet.	Weight per lineal foot.	Size of joist.
ft.	lbs.	ins. ins.
6	16	5 × 3
8	16	6 × 3
10	26	6 × 5
12	31	8 × 5
14	35	10 × 5
16	35	10 × 5
18	43	12 × 5
20	54	12 × 6
22	42	15 × 5
24	61	15 × 6
26	65	16 × 6
28	84	18 × 7
30	84	18 × 7

The following table gives the number of cubic yards of concrete or masonry per lineal yard in culverts:—

Size.	Arch.	Invert.	Sides.	Height, inside diameter.	Cubic yards per lineal yard.
ft.	ft. ins.	ins.	ft. ins.	ft. ins.	
—	—	—	—	1 6	0·60
—	—	—	—	2 0	0·75
3	0 9	9	1 2	3 3	1·60
4	1 2	9	1 6	4 6	3·30
5	1 2	9	1 10	5 6	4·70
6	1 6	9	2 3	6 6	6·10
8	1 6	9	2 9	8 6	9·0
10	1 6	9	3 6	10 6	11·0

Culverts in masonry, or 5-to-1 lime concrete, sides and invert, with timber bearers or rolled joists:—

Width.	Height.	Sides.	Invert.	Cubic yards per lineal yard.	Length of top girder.	Size of timber.
ft. ins.	ft. ins.	ft. ins.	ins.		ft. ins.	ins. ins.
2 6	5 0	2 3	9	21 $\frac{1}{2}$	5 6	12 x 6
5 0	7 6	2 6	9	5	8 6	12 x 6
10 0	13 0	3 3	9	11 $\frac{1}{2}$	13 0	14 x 12

## CHAPTER VI.

*LOCOMOTIVES AND ROLLING STOCK.*

A GREAT argument in favour of constructing light railways in a poor country, and where little traffic is in sight, or the probable increase small, on a different gauge from the main line, is, that you can suit the rolling stock to the work it has to do, and so proportion the dead weight to the live load more advantageously than can possibly be done on main lines, where the speed is considerable, and where much shunting is inevitable.

Light rolling stock cannot run intermixed with heavy stock, as it would come to grief in the different shunting operations, and, moreover, it would be an element of danger in running at high speeds. The slightest check in the speed of a goods train running downhill, or on a curve, would have a tendency to jump a light waggon, in contact with a heavy one, off the road; and railway managers will not allow an indiscriminate use of light and heavy rolling stock in one train.

It is not practicable to run a train of light rolling stock by itself on a main line, as the main-line train passing the several junctions may only have one truck to pick up here and there, and could scarcely get a full load of light rolling stock in the whole length of its journey. Even if this could be done, it is not possible to keep the light rolling stock separate from the heavy stock at station yards and junctions; and in the shunting operations, the light rolling stock must be considerably damaged.

For light railways to earn the interest on capital, and at the

same time to carry produce at a low rate, advantage must be taken of every item where economy can be made, and, if economical working is a feature—and it must necessarily be an important feature in every railway—the rolling stock on light railways must be built for the work it has to do.

In our main lines carrying traffic long distances, the working expenses are influenced by the increased capacity of the waggons, and the consequent reduction of the dead weight to the live load, and by the increase of the paying load drawn by increased power of the locomotives.

It is the object of good management to make up the load on the train as large as possible, and reduce the number of trains. This is, of course, sound policy, but the same rule cannot apply to light lines, as there is not the same amount of traffic to handle, nor the same distance to haul. Were it followed on light lines, the service of trains would, perhaps, be one every other day, instead of, as it should be to give proper facilities to a district, at least two trains each way per day; and statistics show that, for distances up to 125 miles, even on main lines, small waggons are better.

If, therefore, this service is to be obtained, the locomotives and waggons must be designed accordingly, and we must not employ large engines and trucks to do the work that can easily be done by small ones.

The maintenance of the permanent way, both in labour and in renewals, is governed in a great measure by the weight passing over it daily, and if, in the carrying of the traffic, we employ vehicles having a greater dead weight in proportion to the paying load, so much more have we to pay for maintenance expenses. The cost of haulage per train mile is the same whether the engine pulls live or dead load; but the revenue per train mile is, of course, more, the greater the paying load is to the dead load.

**Locomotives.**—These should generally be of the tank type, with four or six wheels coupled according to the work to be done, but every engine should have more than four wheels. A four-wheel engine is generally very unsteady in its running, and destructive to the road, causing increased cost of maintenance. Four-wheel-coupled engines

should have a radial axle or a bogie, to give greater steadiness. The engine should not be heavier than is required to produce the necessary tractive force by adhesion, and the weight on the driving wheels must be proportioned to the weight of the rails.

Unless the traffic is very heavy, or other conditions are unfavourable, a four-wheel-coupled engine is to be preferred to any other, both on account of the facility it has in passing round curves, and of its being less destructive to the road. In these light engines the hand-brake should be placed conveniently for the driver to work, so as to dispense with a great portion of the labour of the fireman on the engine. The fireman would act, when required, as brakesman to the front of the train, and would assist in all shunting operations, whilst the guard would attend to the brakes at the rear of the train.

The speed on these light lines will necessarily be slow for goods traffic, and, except in special cases, continuous brakes will not be required; but a simple arrangement might be adopted, by which the lever-brakes could be lowered from the engines by means of a cord. The engines should have a gangway along each side and at the ends, as is now done on contractors' engines in this country, so that the firemen might easily pass from the engine to the adjoining vehicle.

The cost of fuel and repairs may be kept at a minimum by keeping the speeds on gradients (below the ruling gradient), and on the level within proper limits, which on the level should not exceed 18 miles per hour for passenger trains, and 12 miles per hour for goods trains. Engines for light railways can be designed to have a tractive force per ton weight of about 321 lbs., including friction, and the speed required to develop the maximum tractive force is 7 miles per hour, and this should be the speed on the steepest gradient. The haulage load on the various gradients will therefore be—

MAXIMUM WEIGHT OF TRAIN IN TONS ON GRADIENT OF (EXCLUSIVE OF ENGINE)—

Engine weight. Tons.	Tractive force. Tons.	1 in 200.	1 in 100.	1 in 80.	1 in 60.	1 in 50.	1 in 40.	1 in 30.	1 in 25.	1 in 20.
1 .. $7\frac{1}{2}$	1.0	132	75	61	46	38	30	21	16	12
2 .. $11\frac{1}{4}$	1.5	200	113	92	70	57	45	31	25	18
3 .. 15	2.0	265	150	122	92	75	59	42	33	24
4 .. $22\frac{1}{2}$	3.0	400	225	183	128	114	89	63	49	35

The watering stations may be placed at a distance of two hours' run, as it would scarcely ever happen that the engine would have to exert its maximum power for so long a time. These stations should also be of the simplest character, and were the engine fitted with a pump, no overhead tank would be necessary along the line at any place, except at the engine-sheds. The coaling stations might be arranged at every second water-tank. For extra long runs, or in places where it would be difficult to get water or store coal, a tender would have to follow the engine.

For passenger and parcel traffic on lines with light traffic, a steam carriage may be advantageously used. It can be constructed to hold from 60 to 100 passengers, and travel at a speed of 25 miles an hour, or even up to 37 miles an hour, if necessary. The steam-carriage alone consumes about 7 lbs. of coal per hour, and can be constructed to carry water and coal for a 50-mile run. There is a great saving effected in using these carriages, as the working expenses and maintenance of the road is less than one-half that of an ordinary light railway, and the travelling is quite smooth and safe. The carriage can be started and stopped much more quickly than a small train, and as the passengers themselves supply the extra weight required for adhesion, there is consequently a great reduction in the dead weight of the steam-carriage itself. The cost of a carriage varies from £600 to £1500.

**Compound Locomotive.**—The illustration (Fig. 5A) shows a type of compound locomotives—there being one high-pressure cylinder exhausting into a reheating receiver in the hot-smoke box, and thence into the two low-pressure cylinders outside—this gives the same number of exhausts as an ordinary locomotive, and is effective in making a steady blast.

The engine, one of several built by the Avonside Engine Company, for a 2 ft. 6 ins. gauge railway in South America, is of the dimensions given in the subjoined list (p. 54).

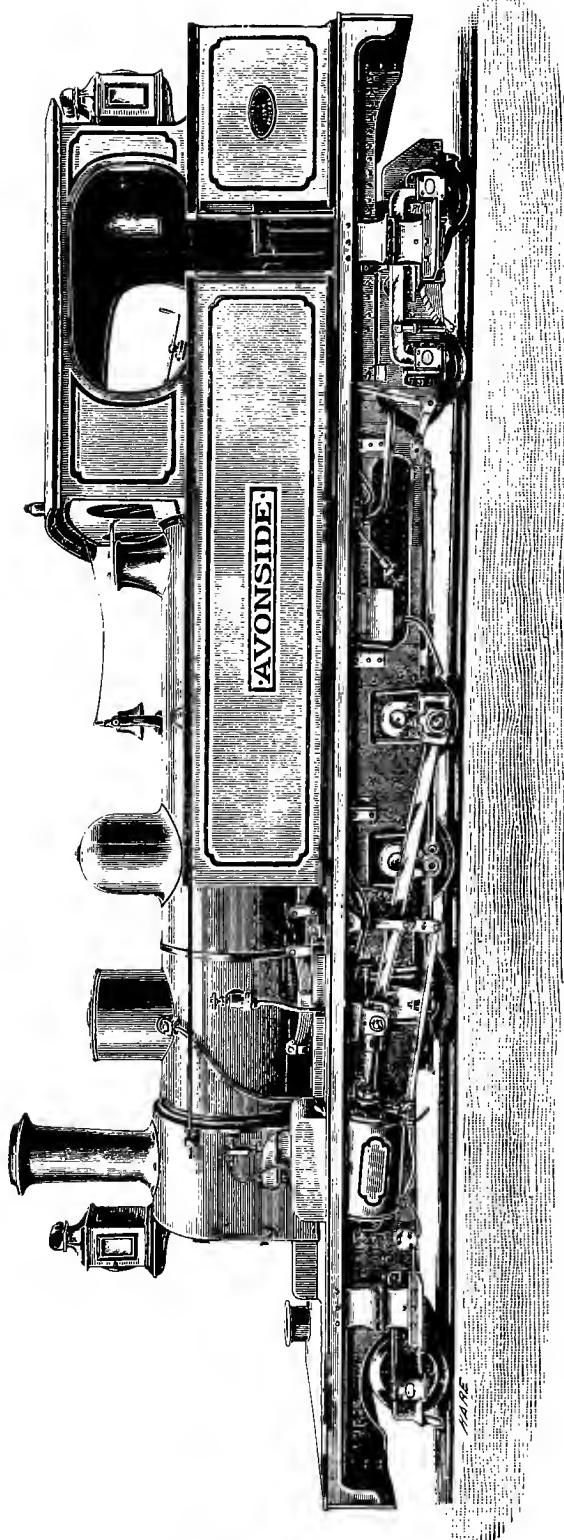


FIG. 5A.—Locomotive on the Antofagasta and Bolivia Railway.

## DIMENSIONS OF ENGINE ILLUSTRATED IN FIG. 5A (p. 53).

1 high-pressure cylinder	...	...	...	15 ins. by 16 ins. stroke.
2 low-pressure cylinders	...	...	...	," 20 "
Fixed wheel-base	...	...	...	7 ft.
6 coupled wheels	...	...	...	3 ft. in diameter, centre wheels having no flanges.
Trailing bogie (4 wheels)	...	...	...	2 ft. in diameter.
Leading pony truck (2 wheels)	...	...	...	do.
Heating surface, tubes	...	...	...	676 square feet.
" fire-box	...	...	...	70 "
Tank capacity	...	...	...	860 gallons.
Bunker capacity	...	...	...	90 cubic feet.
Working pressure	...	...	...	180 lbs. per square inch.
Weight on any axle not exceeding 7 tons	...	...	...	Total weight, 37 tons, in working order.
Sleepers are spaced about 2 ft. 5 ins. centres.				Rails, 36 lbs. per yard.

In order to make an engine with a long total wheel-base accommodate itself to the road, all the coupled wheels and the pony truck are compensated together, and to give great lateral flexibility when on sharp curves the hind bogie and front pony truck are free to move 9 ins., subject to controlling springs. The draw gear also—which pulls from a point near the centre coupled wheels—can move laterally 10 ins. at the buffer beam.

The adoption of compound engines was determined by the great cost of fuel and water they were to use, and it has been found in actual working that they save about 25 per cent. on these items over plain engines doing the same work. The engines are reported to run very steadily, and are probably the largest engines made for the 2 ft. 6 ins. gauge.

The reversing handles are arranged so that both high and low-pressure cylinders may be worked in various grades of expansion. The sanding is done by Gresham's steam sanding apparatus. The starting apparatus is by a simple valve which admits a small amount of high-pressure steam into the low-pressure cylinders, and it has been found in practice to be very effective. There is a safety-valve on the receiver to blow off at 125 lbs. per square inch. The engines have cabs of commodious pattern, having a clear working space for driver and stoker of 6 ft. by 4 ft. 6 ins.

The tractive force of these engines is 10,870 lbs.

The following Table gives details of the various types of locomotives shown in Figs. 6-11 (see next page):—

TABLE C.

## PARTICULARS OF LOCOMOTIVES IN ACTUAL USE.

		*	Fig. 6.	Fig. 7.	Fig. 8.	Fig. 9.	Fig. 10.	Fig. 11.
Weight of rails on which engine is now working ..	lbs.	20	26½	30	30	40	36	36
Gauge of railway on which engine is now working ..	feet	2 0	2 0	2 6	2 0	2 0	2 6	2 6
Diameter of cylinders ..	ins.	8½	9½	9	9	11	12	13
Stroke of cylinders ..	"	11½	12½	16	14	14	18	18
Diameter of coupled wheels ..	feet	2 0	2 1½	3 3	2 8	2 2	2 9	2 9
Rigid wheel-base .. ..	"	3 0	4 7	6 3	5 4	5 6	6 5	6 9
Coal capacity .. ..	cwts.	25	30	40	12	—	15	20
Water .. ..	galls.	760	900	800	380	600	400	700
Weight of engine in working order .. ..	tons	8½	13	13½	14½	13½	25	28
Tractive force .. ..	lbs.	2240	3360	3360	3543	5000	7700	9100
Gross load hauled up (exclusive of engine)—								
1 in 80 .. ..	tons	61	92	92	98	137	213	244
1 „ 40 .. ..	"	30	45	45	48	66	105	118
1 „ 25 .. ..	"	16	25	25	27	37	57	66
Radius of curves round which engine will pass freely ..	feet	49	82	100	70	70	132	165
Price of locomotive .. ..	£	846	1136	1020	926	—	1665	1860

\* Similar to Fig. 6, but with four wheels coupled.

**Waggons and Carriages.**—For lines of light traffic the most economical waggons are those of the four-wheel type, carrying 5 to 6 tons in paying load, and weighing from 1½ to 2 tons. This gives a proportion between live and dead load of 3 to 1. Bogie trucks can be used for special purposes, such as the conveyance of cattle or other special traffic; but trucks can be so arranged that small animals, as sheep, goats, or calves, can be conveyed in the ordinary waggons in use.

Bogie trucks are not suitable generally for short lines, say under 125 miles in length, where the traffic is distributed throughout the length of the line, and which has to be picked up here and there. These trucks will carry 10 tons, and having a fair cubic capacity, it is not easy to get them fully loaded at one station; consequently there is a probability of their being only partly loaded, and a mass of dead weight is added to the train for no purpose. It is also more

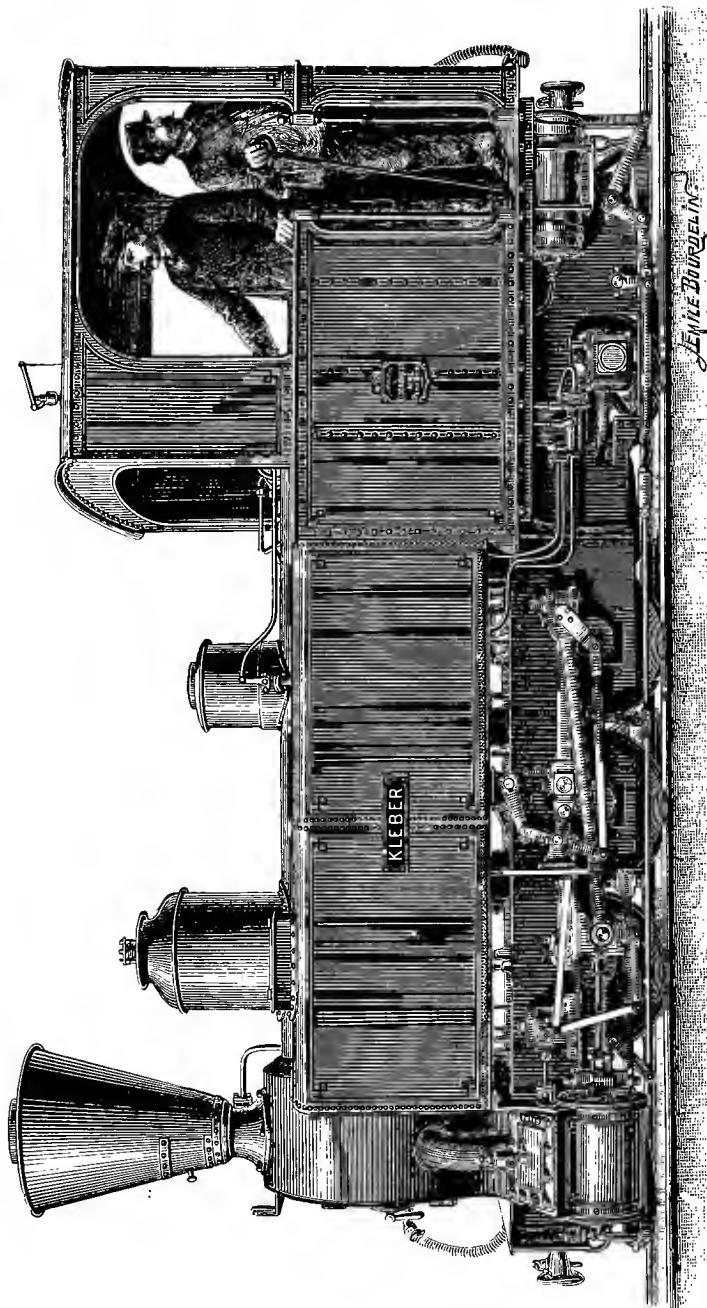


FIG. 6.—Gauge, 2 ft.; rail, 26½ lbs.

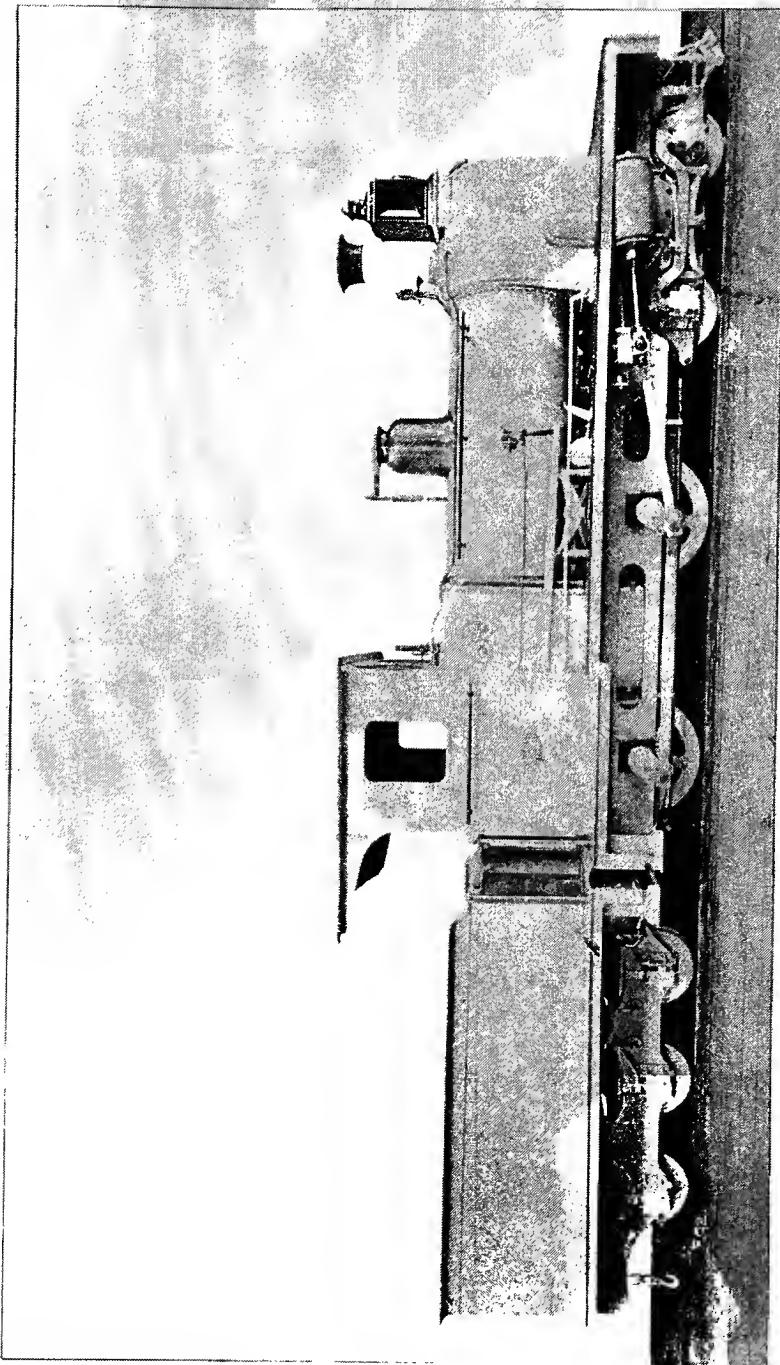


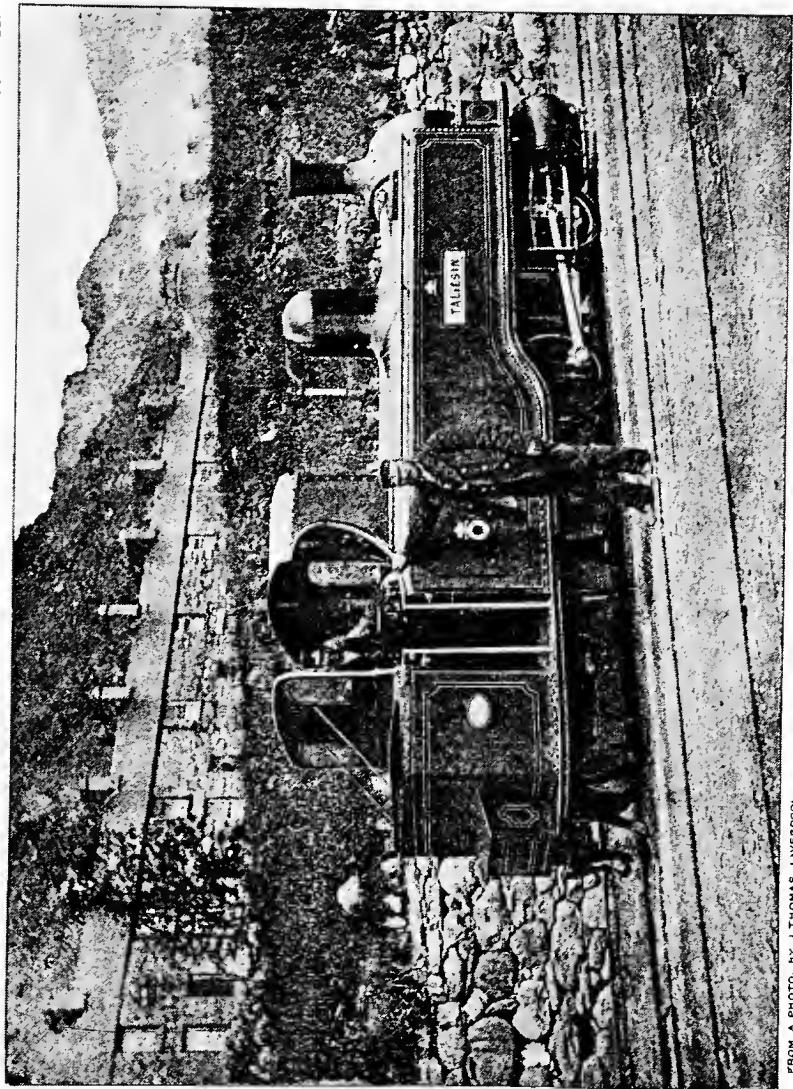
PHOTO. FROM PENNEY & CO

FIG. 7. LOCOMOTIVE ON THE MORVI RAILWAY.

IN PHOTO. SPRAGUE & CO LONDON.



PLATE II.



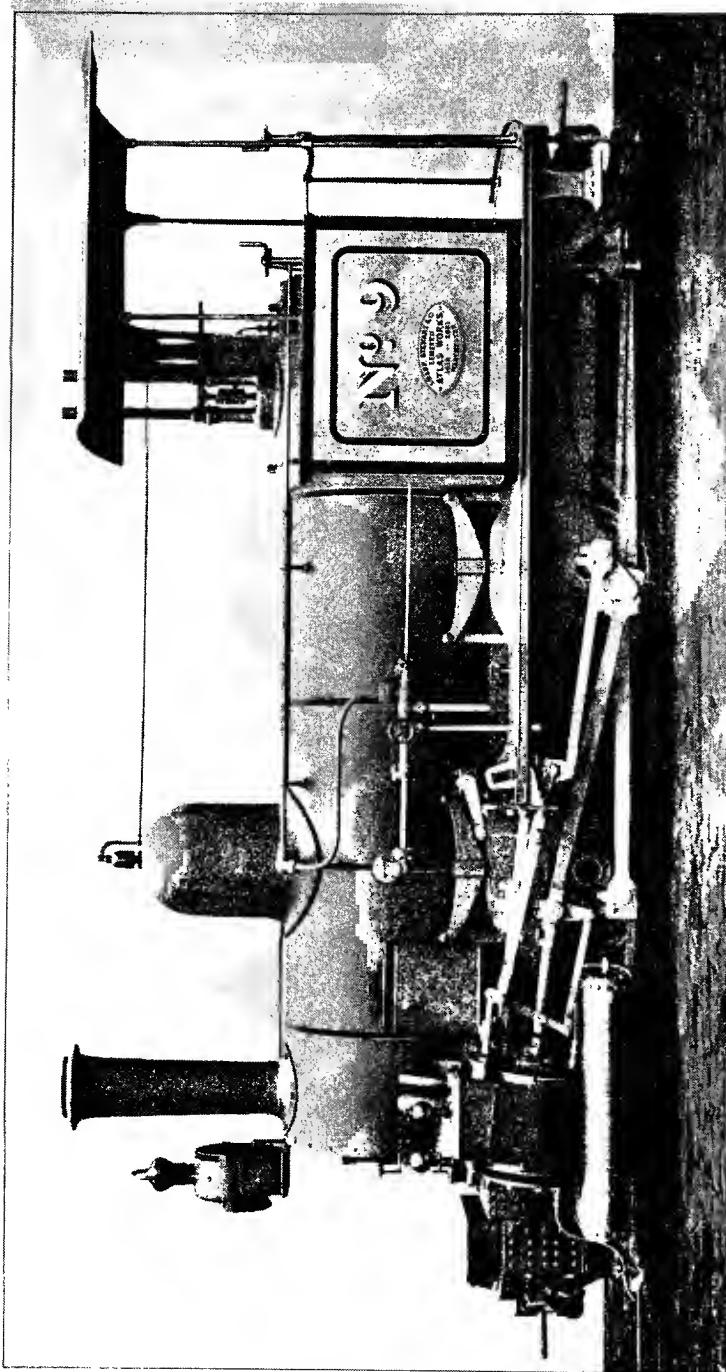
FROM A PHOTO. BY J. THOMAS, LIVERPOOL.  
INK-PHOTO. SPRAGUE & CO. LONDON.

FIG. 8. LOCOMOTIVE ON THE FESTINIOG RAILWAY.

[Between pp. 56 and 57.]



PLATE III.



NUPHOTO SPRAGUE & CO. | OREGON

FROM A PHOTO: BY F. MOORE. LONDON.

FIG. 9. LOCOMOTIVE ON DARJEELING RAILWAY.



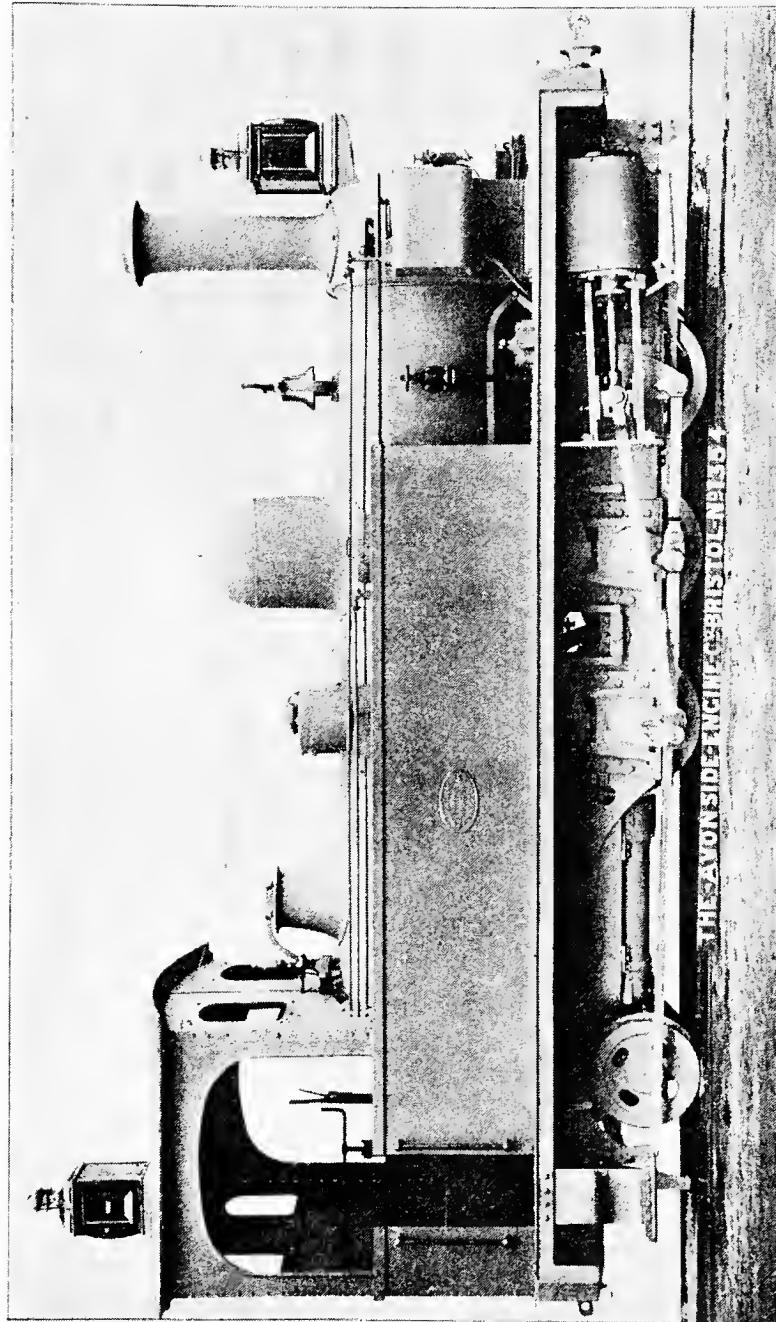
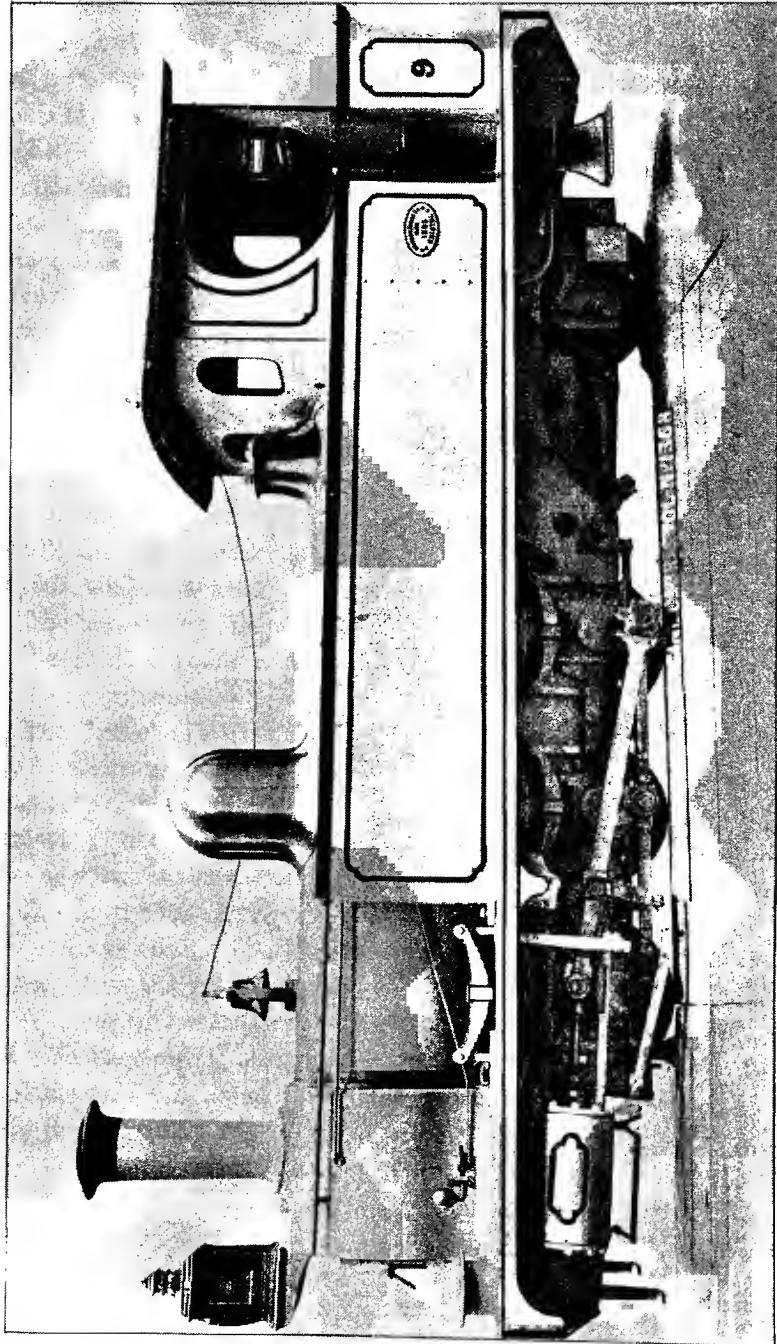


FIG. 10. LOCOMOTIVE ON ANTOFAGASTA AND BOLIVIA RAILWAY.

IN PHOTO SPRAGUE & CO LONDON



PLATE V.



IMP. PHOTO. SPRAGUE & CO. LONDON.

FIG. II. LOCOMOTIVE ON ANTOFAGASTA AND BOLIVIA RAILWAY.



economical in working light lines to have as few types of waggons as possible, and it will generally be found that waggons about 14 ft. long and 6 ft. 6 ins. to 7 ft. wide, inside measurement, according to the gauge of 2 ft. 6 ins. or 3 ft. 6 ins., will be large enough for ordinary traffic.

The open waggons can be 1 ft. 3 ins. deep, whilst waggons 3 ft. deep, with a cross-bar from end to end on top, on which can be stretched a net for cattle, and a tarpaulin for covering goods, will serve for both a cattle-truck and a covered van, with wheels 1 ft. 10 ins. diameter.

The waggons can be of light construction, as although they may be made strong enough to carry five tons at low speeds, it will be found in practice that they will scarcely ever be called upon to carry this weight on the lines under consideration. These waggons would not cost more than £45 each. The lightest waggons on the ordinary 4 ft. 8½ ins. gauge working on the main lines, carrying 6 tons, weigh 4½ tons, whilst the same waggons on the narrow gauge weigh 2 tons.

The passenger carriages would also be on the same scale of lightness as the goods waggons, and it may be advisable to construct these on the bogie principle.

The first-class carriages may be either divided into square compartments seating nine passengers, arranged with sleeping berths and lavatory arrangements, or with the seats longitudinally, as in a tramcar. They should not weigh more than from 220 to 320 lbs. per passenger, and the cost will be about £10 to £14 per passenger carried.

The third-class carriages can be both opened and closed, according to the class of traffic, and should weigh from 220 lbs. per passenger, and cost from £4 per passenger.

It is not advisable to have more than two classes on light railways, and if short of rolling stock at any time, the goods waggons should be available for fitting up as third class, and might be so designed as to serve this purpose.

TABLE D.  
QUANTITY OF ROLLING STOCK USED ON SEVERAL RAILWAYS.

Full particulars of these railways will be found in Chapter X.

\* Small trucks for special traffic.

## INDIAN SPECIAL GAUGE (2 ft. 6 ins. and 2 ft. 0 ins.) RAILWAYS.

	Johat.	Darjeeling.	Gackwai.	Morvi.
<i>Locomotives—</i>				
Locomotives on list, total .. ..	7	16	6	11
Average number constantly under repair ..	1	0·05	1	1
<i>Coaching (vehicles)—</i>				
Total on list .. .. .. ..	10	56	31	34
Average number constantly under repair ..	1	1·5	1	2·25
<i>Vehicles—</i>				
Goods .. .. .. ..	71	167	200	97
Average number constantly under repair ..	3	3	3	6
Brake-vans .. .. .. ..	—	—	6	6
Total vehicle stock on list .. .. .. ..	81	223	237	137
Average number constantly under repairs ..	4	4·5	4	8·75
Locomotives per mile .. ..	0·26	0·31	0·08	0·11
Coaches .. ..	0·37	1·1	0·43	0·36
Vehicles .. ..	2·63	3·27	2·77	1·0

## PASSENGER CARRIAGES FOR LIGHT RAILWAYS.

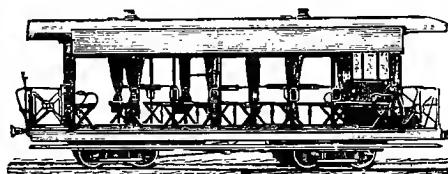


FIG. 12.—Open Third-class Carriage.

Weight of rails ...	...	...	...	...	...	30 lbs.
Gauge of railway ...	...	...	...	...	...	2 ft. 6 ins.
Length of carriage ...	...	...	...	...	...	23 ft. 7 ins.
Width ,,, ...	...	...	...	...	...	6 ft. 3 ins.
Weight of carriage carrying 32 passengers ...	...	...	...	...	...	3 tons 5 cwt.
Diameter of wheels ...	...	...	...	...	...	22 ins.
Centres of bogies ...	...	...	...	...	...	12 ft. 9 ins.
Price ...	...	...	...	...	...	£200

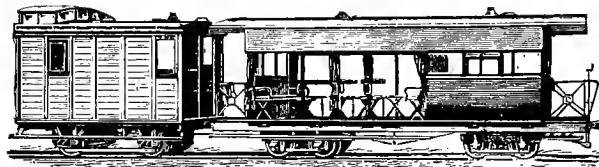


FIG. 13.—Composite Carriage.

Weight of rails	...	...	...	...	...	30 lbs.
Gauge of railway	...	...	...	...	...	2 ft. 6 ins.
Length of carriage	...	...	...	...	...	24 ft. 3 ins.
Width	”	...	...	...	...	6 ft. 3 ins.
Weight of carriage carrying 10 first and 22 third-class passengers (= 32)	...	...	...	...	...	3 tons 18 cwts.
Diameter of wheels	...	...	...	...	...	22 ins.
Centres of bogies	...	...	...	...	...	13 ft. 5 ins.
Price, as above illustration	...	...	...	...	...	£250
First class only	...	...	...	...	...	£280

*Brake van, with postal compartment.*

Length, total	...	...	...	...	...	12 ft.
Length postal compartment	...	...	...	...	...	5 ft. 6 ins.
Width of carriage	...	...	...	...	...	6 ft. 3 ins.
Wheel base	...	...	...	...	...	6 ft.
Weight	...	...	...	...	...	2 tons 17 cwts.
Price	...	...	...	...	...	£147

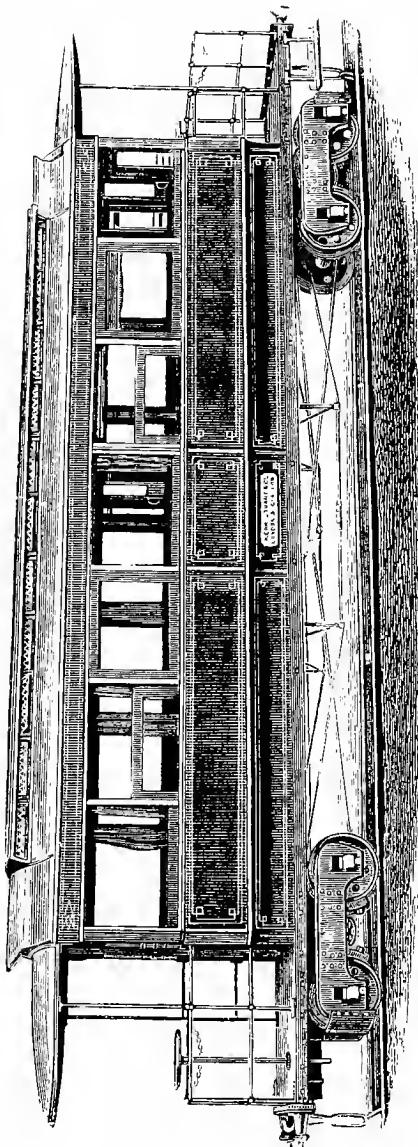


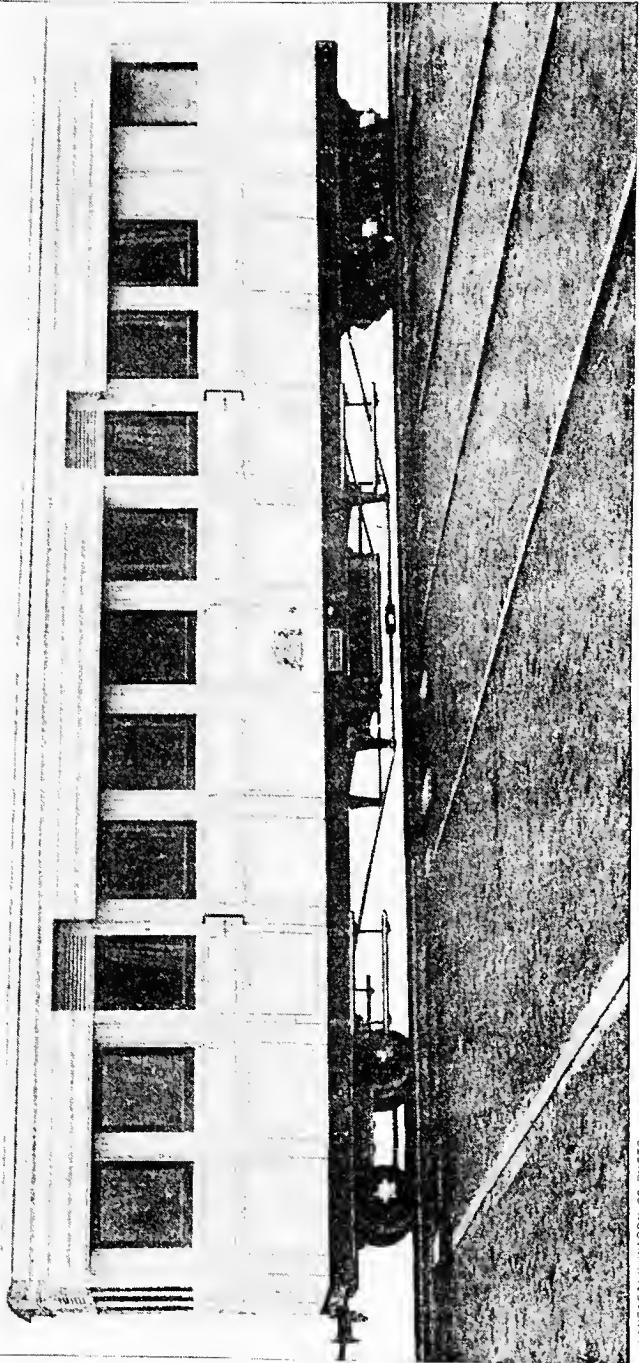
FIG. 14.—Bogie Passenger Carriage.

The above illustrates a closed bogie tramcar for steam traction. It is constructed to carry from 30 to 50 passengers, and from 2 ft. 6 ins. gauge and upwards.

Change of railway	...	...	...	...	...
30 Passengers	...	...	...	...	£245
40 Passengers	...	...	...	...	£255
50 Passengers	...	...	...	...	£270

## PLATE VI. (FIG. 15).—BOGIE SALOON CARRIAGE.

Weight of rails	...	...	...	...	...	...	25 lbs.
Gauge of railway	...	...	...	...	...	...	2 ft. 6 ins.
Length of carriage	...	...	...	...	...	...	29 ft. 6 ins.
Width	"	...	...	...	...	...	6 ft. 7 ins.
Height inside	...	...	...	...	...	...	6 ft. 9 ins.
Price of first-class carriage carrying 19 passengers						...	£450
Price of second-class carriage carrying 43 passengers						...	£320



LANCASHIRE WOOD CO. PHOTO

FIG. 15. BOGIE SALOON CARRIAGE.

[Between pp. 62 and 63.]



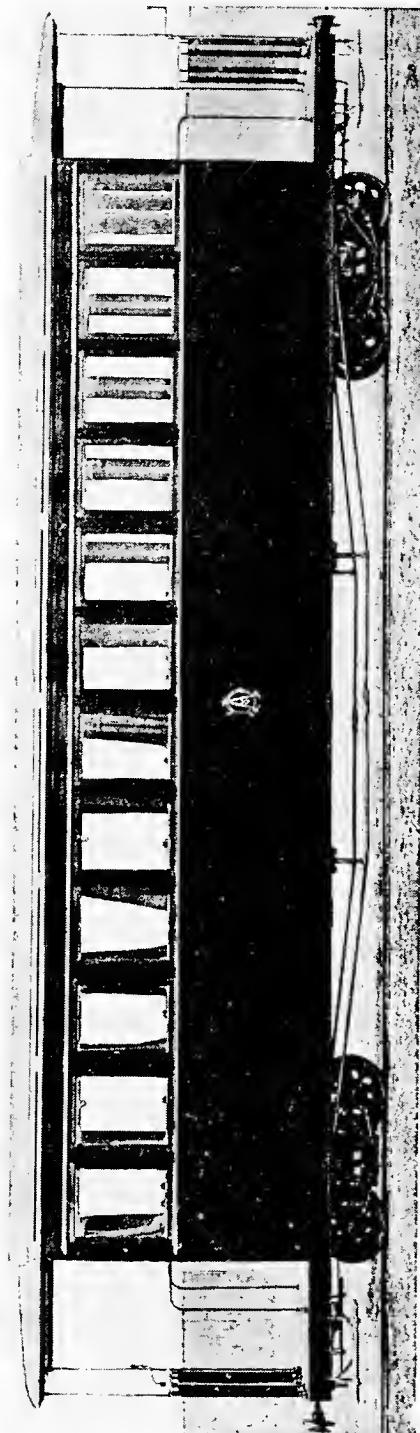


Fig. 16.—First Class.

Gauge 2 ft. and upwards; to carry 32 passengers. Price £300.

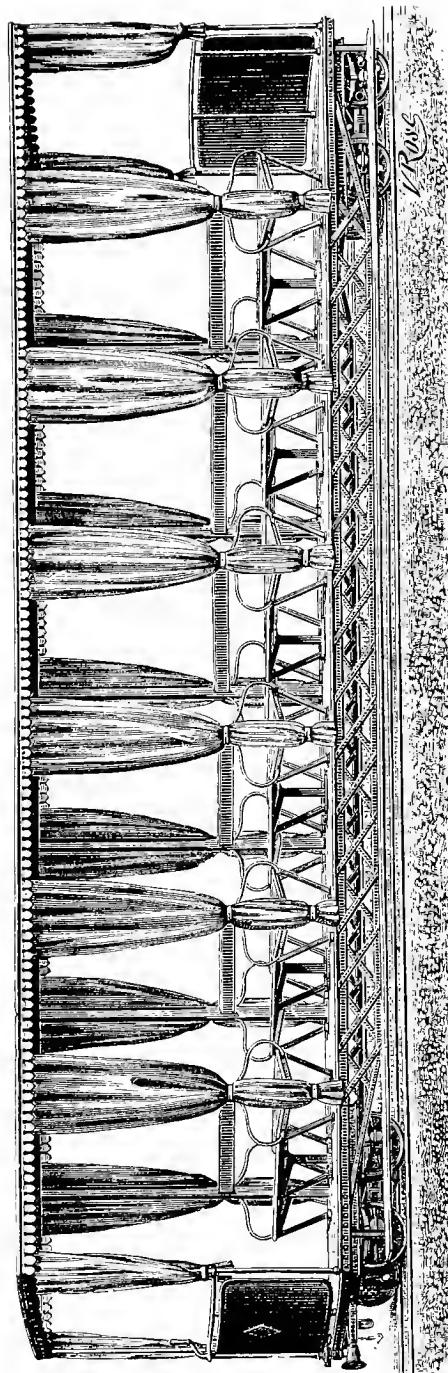
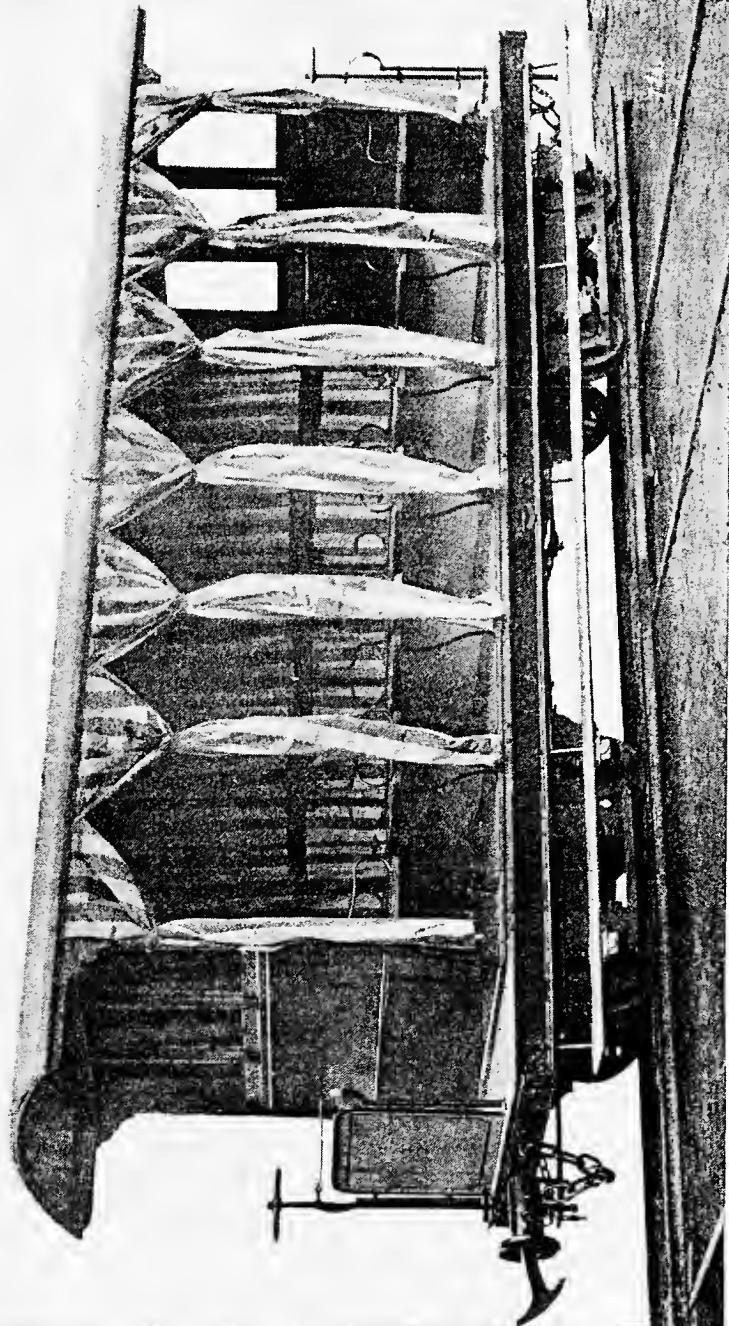


FIG. 17.—Third Class.

Gauge 2 ft. and upwards; to carry 56 passengers. Price £116.



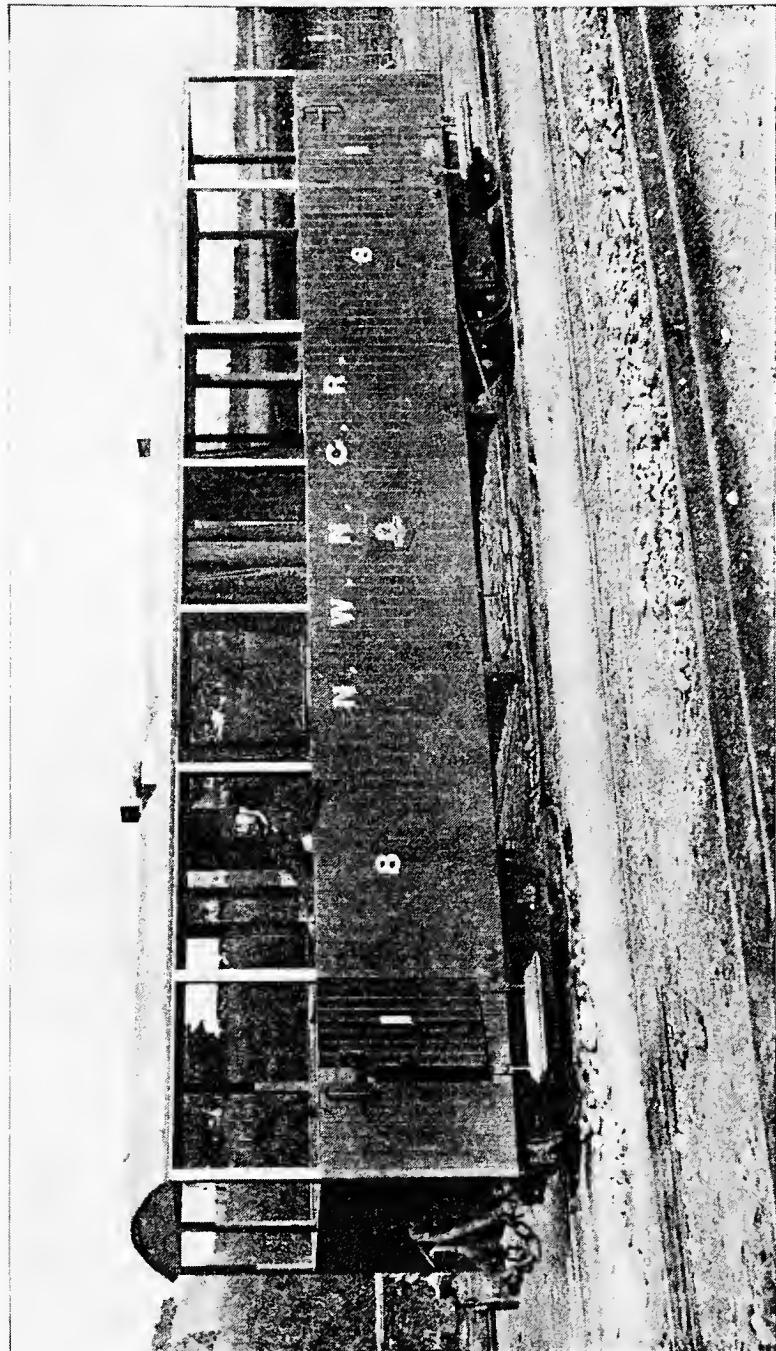
LANCaster Wagon Co. PHOTO.

THIRD CLASS.

Imp. PHOTO SPRAGUE & CO. LONDON.

[Between pp. 64 and 65.]



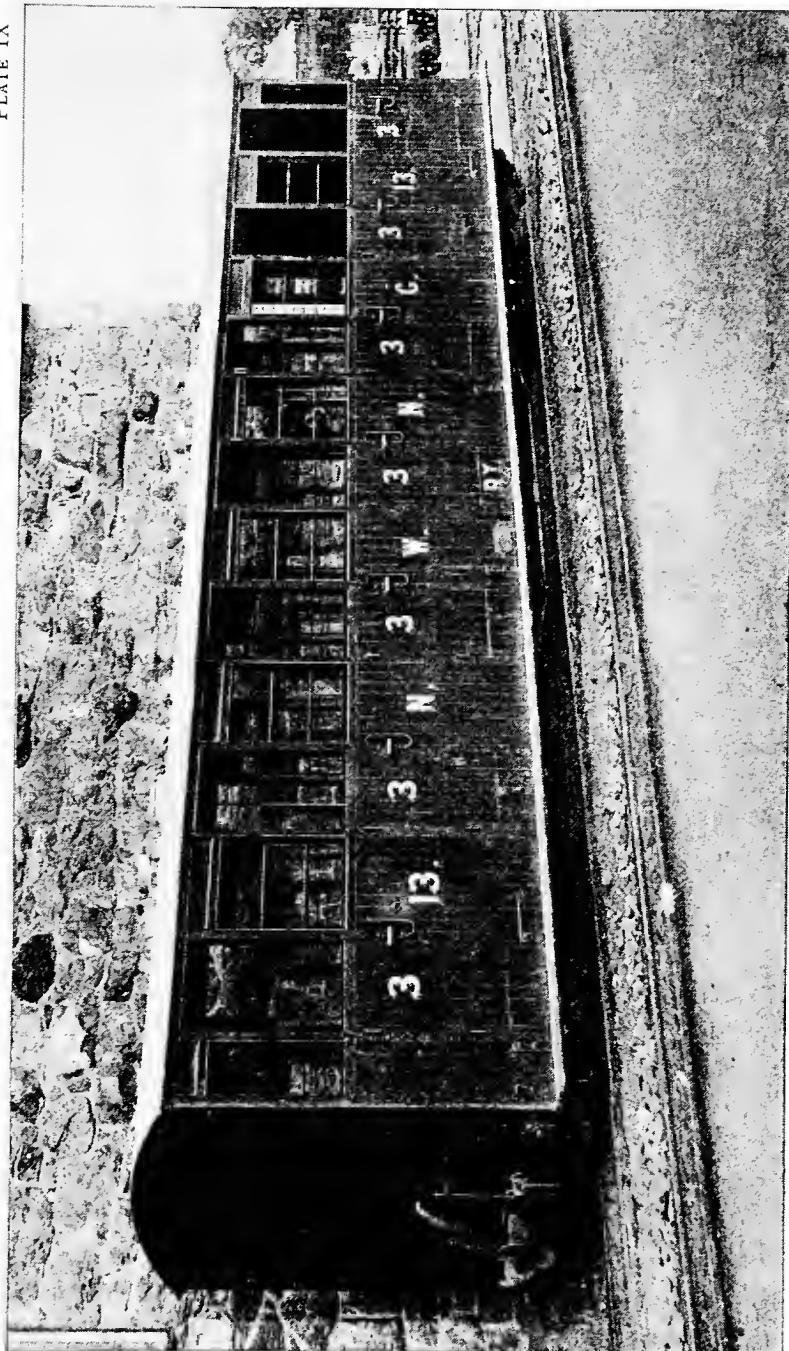


FIRST CLASS, OPEN EACH END, WITH CLOSED COMPARTMENT IN CENTRE

[Between pp. 64 and 65]

IN PHOTO SPRAGUE & CO LONDON





THIRD CLASS CARRIAGE, NORTH WALES NARROW GAUGE RAILWAY

IMPHOTO SPAGHETTI & CO LONDON

[Between p. 64 and 65.]



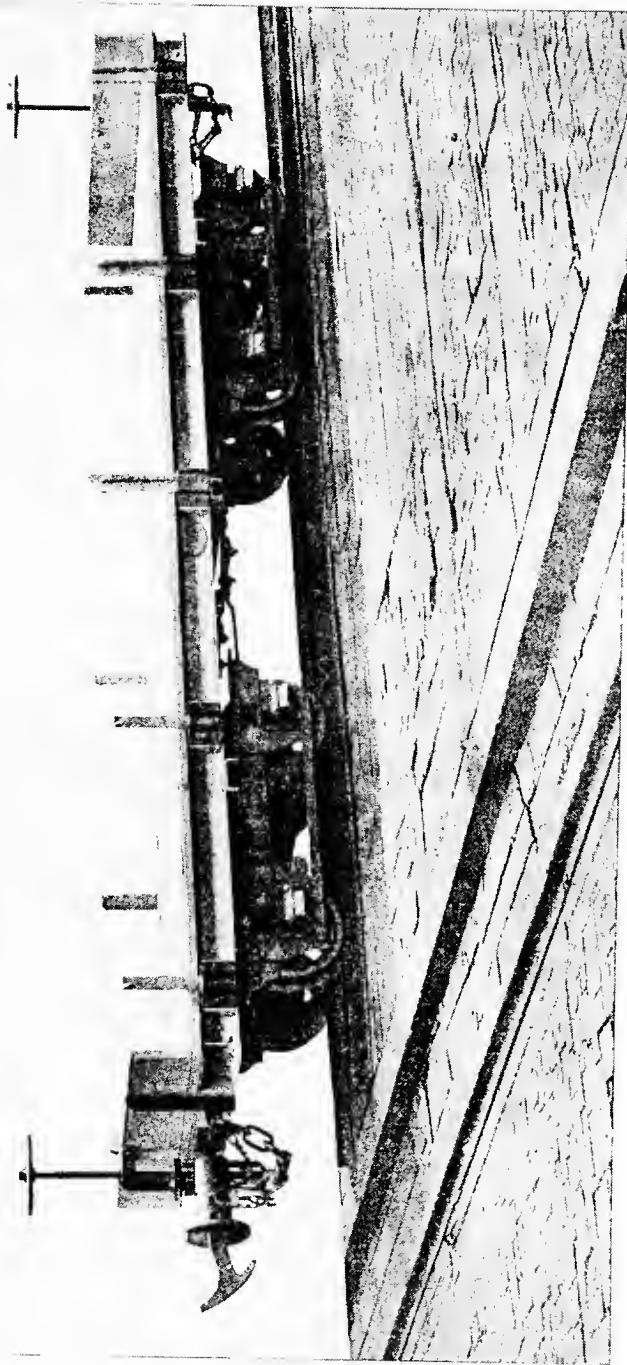


FIG. 18 GOODS WAGGON

INSPECTOR SPRAGUE & CO LONDON

[Between pp. 64 and 65.

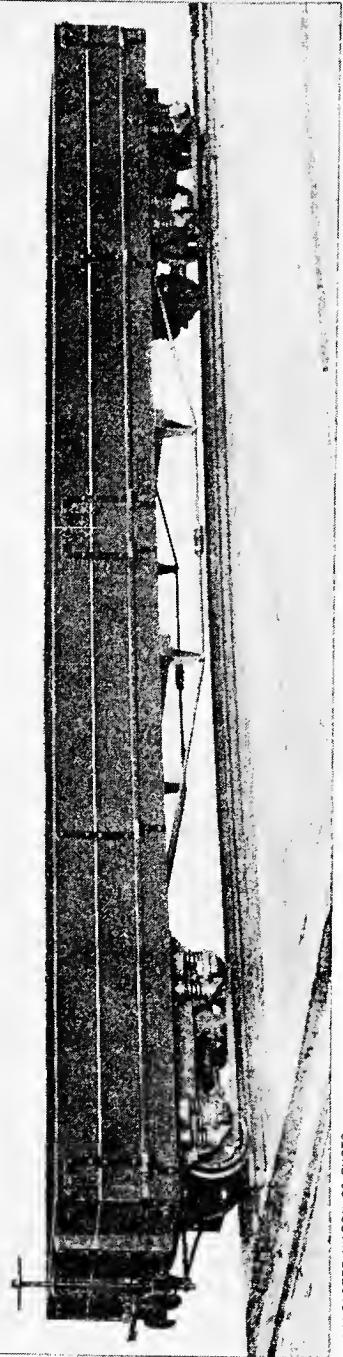


## PLATE X. (FIG. 18).—GOODS WAGGON.

Weight of rails	...	...	...	...	...	25 lbs.
Gauge of railway	...	...	...	...	...	2 ft.
Length of waggon	...	...	...	...	...	16 ft. 2 ins.
Width ,	...	...	...	...	...	5 ft.
Height of side	...	...	...	...	...	9 ins.
Load carried	...	...	...	...	...	4 tons.
Weight of waggon	...	...	...	...	...	1 ton 18 cwts.
Price	...	...	...	...	...	£41

## PLATE XI. (FIG. 19).—GOODS WAGGON.

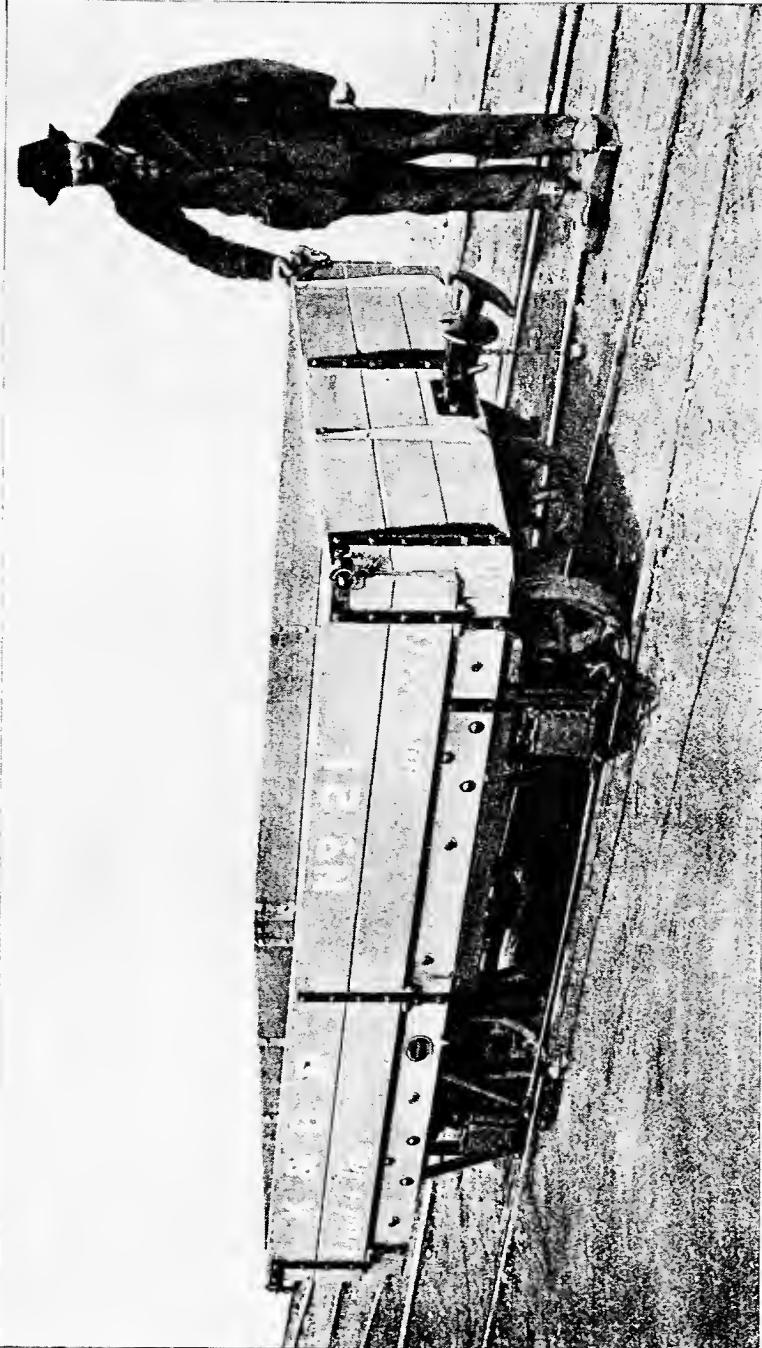
Weight of rails	...	...	...	...	...	25 lbs.
Gauge of railway	...	...	...	...	...	2 ft.
Length of waggon	...	...	...	...	...	29 ft. 9 ins.
Width ,	...	...	...	...	...	5 ft. 3 ins.
Height of sides	...	...	...	...	...	1 ft. 6 ins.
Load carried	...	...	...	...	...	8 tons.
Weight of waggon	...	...	...	...	...	3 tons 15 cwts.
Price	...	...	...	...	...	£89.



INK PHOTO SPRAGUE & CO LONDON

FIG. 19. GOODS WAGGON.





METROPOLITAN WAGON C° PHOTO

GOODS WAGGON.

1/4 PHOTO SPRAGUE & CO LONDON

[Between pp. 66 and 67.]



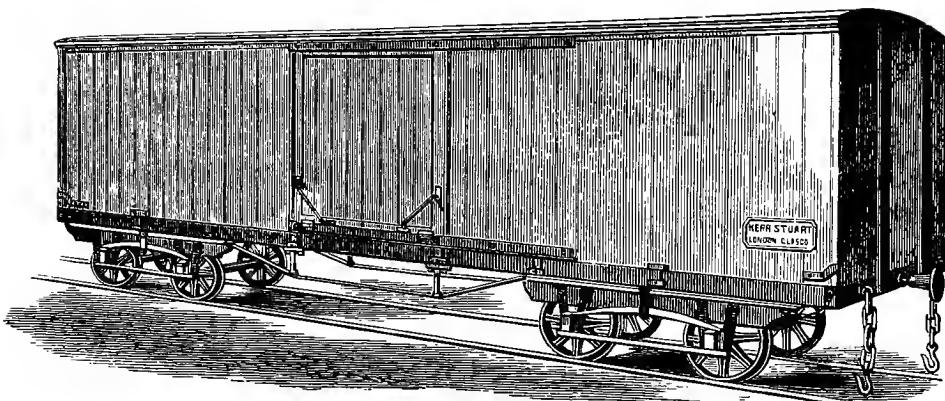


FIG. 20.—Bogie Covered Goods Wagon.

The above wagon is specially adapted for carrying large loads on narrow-gauge lines. The underframing is of wrought iron channel section, strongly stayed. The framing of body is of wood with match-boards of best red deal on outside, or, if for a tropical climate, iron plates. The roof is of stout canvas bedded in paint, and perfectly watertight. For tropical climates an extra outside roof of corrugated iron is recommended. The side-doors arranged to slide, and fitted with rollers and guides. The wheels are of chilled cast iron or steel. If required, the wagon can be fitted with a screw brake worked from guard's seat on the roof or from a platform at end of wagon.

Gauge.	Length.	Width.	Height.	Price.
ft. ins. 2 0	ft. ins. 20 0	ft. ins. 5 6	ft. ins. 6 0	£145
2 6	25 0	6 0	6 0	£145
Metre, or 3 6	25 0	6 6	6 0	£150

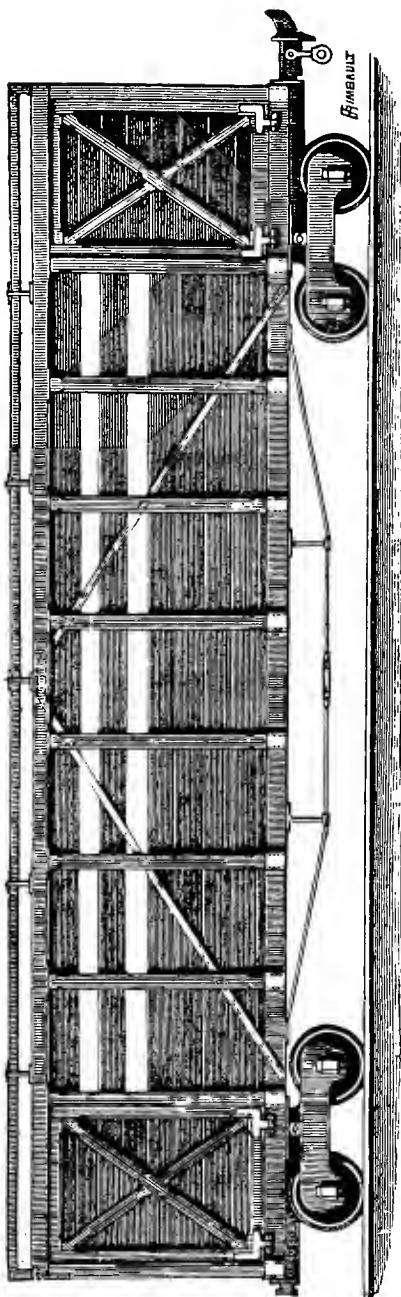


FIG. 21.—Cattle Truck.

The above type of cattle-truck is suitable for narrow-gauge railways. The cattle stand lengthways in the truck, the entrance and exit being effected at opposite ends. Price of wagon to carry eight to ten oxen—

2 ft. 6 in. gauge	...	...	...	...	...	...	£130
Metre gauge	...	...	...	...	...	...	£150
3 ft. 6 in. gauge	...	...	...	...	...	...	£160

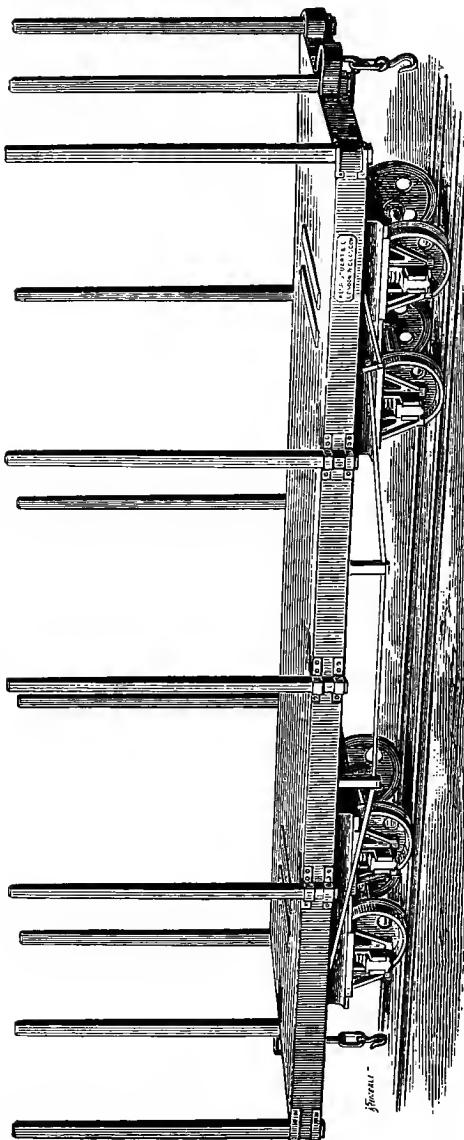


FIG. 22.—Bogie Sugar-cane or Forage Waggon.

The framing of both platform and bogies is of strong channel iron firmly stayed. The floor of wrought-iron plates, the wheels and axles of steel, the axle-boxes fitted with springs.

Rail gauge.	Diameter of wheels.	PLATFORM.		Height o' posts.	Extra for lever brake on one bogie.	Extra for spring central buffers.	Price.				
		ft. ins.	ft. ins.								
2 ft. 0 ins.	1 ft. 2 ins.	12	0	4	6	1	5	0	20	0	0
2 ft. 6 ins.	1 ft. 2 ins.	12	0	5	0	1	5	0	2	10	0
Metre, or 3 ft. 6 ins.	1 ft. 4 ins.	12	0	5	9	1	5	0	2	10	0
						2	s.	d.	2	s.	d.
						0	0	0	0	0	0
						0	0	0	0	0	0
						0	0	0	0	0	0

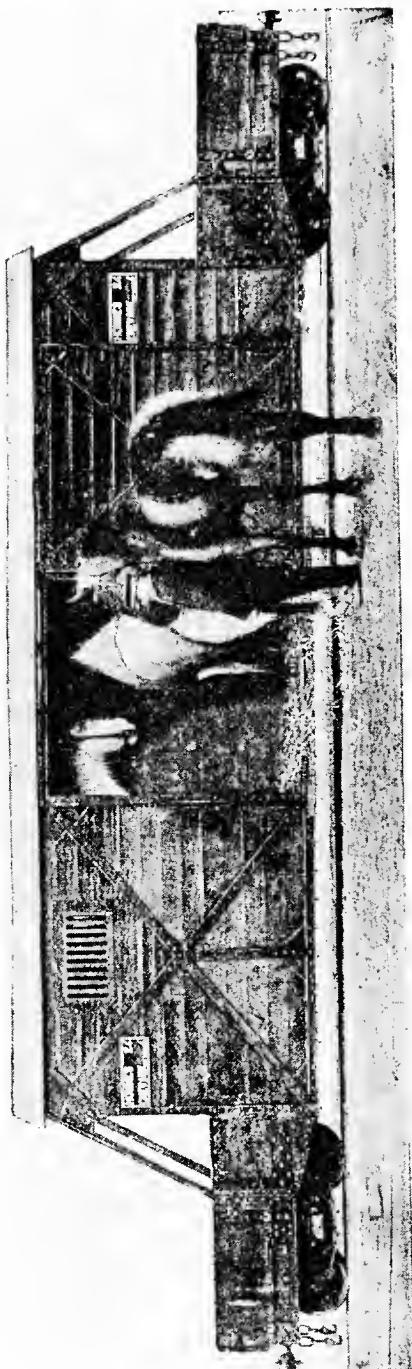
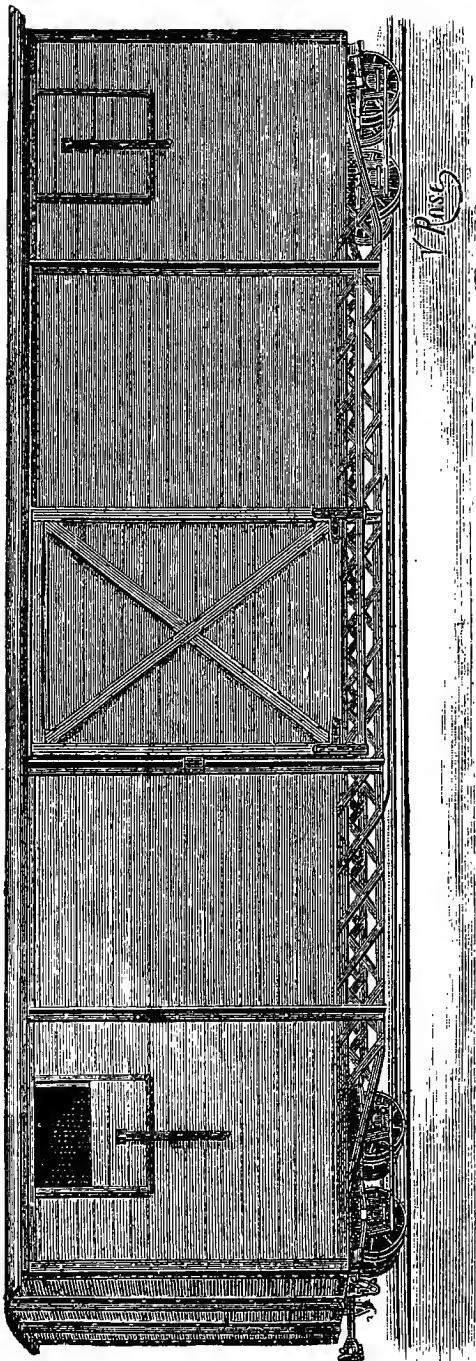


FIG. 23.

Gauge 2 ft. and upwards ; to carry 4 horses. Price £132.



Gauge 2 ft. and upwards. Price £128.

Fig. 24.

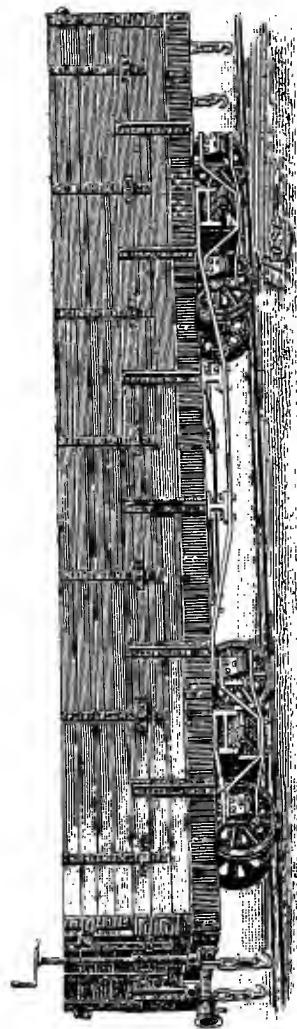


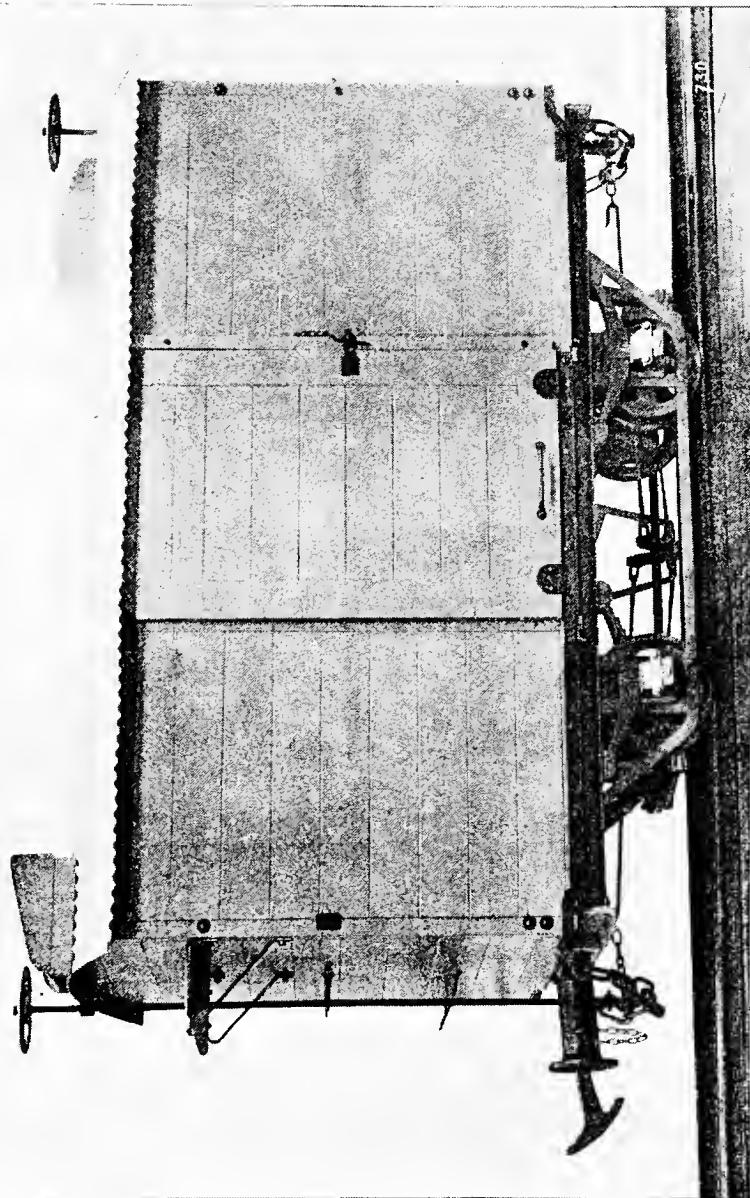
FIG. 25.

Gauge 2 ft. and upwards; load 10 tons, tare 3 tons. Price £120.

## PLATE XIII.

Gauge 2 ft. 6 ins.; load 4 tons, tare 1 ton. Price £51.  
" 3 ft. 6 ins.; load 6 tons, tare 2 tons. Price £75.

PLATE XIII.



COVERED GOODS WAGGON.

IMPHOTO SPRACUT & CO. LONDON

[Between pp. 72 and 73.]



## CHAPTER VII.

*PROBABLE COST OF CONSTRUCTION AND EQUIPMENT.*

THE cost of construction and equipment of any railway, obviously depends on the character of the railway, of the country through which it passes, and the amount of traffic it has to carry. All that can be done here, is to suggest the probable cost of certain railways in easy districts, and to cite what other similar railways have cost, in detail. From this a comparison can be made of various types of railways, which may enable many to form an approximate estimate, of what a particular railway may cost in a certain district.

	WEIGHT OF RAILS, AND GAUGE OF RAILWAY.			
	20 lbs. 2 ft. 0 ins.	30 lbs. 2 ft. 6 ins.	30 lbs. 3 ft. 6 ins.	50 lbs. 3 ft. 6 ins.
Survey .. .. .. ..	25	25	25	25
Engineering and supervision .. .. ..	125	125	125	125
Earthworks .. .. ..	200	250	350	400
Bridges and culverts .. .. ..	200	250	350	500
Permanent way and ballasting .. .. ..	500	730	864	1385
Stations and buildings, etc., say .. .. ..	50	50	60	70
Rolling stock .. .. ..	250	300	350	450
Temporary works and sundries .. .. ..	100	100	100	150
Probable cost per mile .. .. ..	£1450	£1830	£2224	£3105

Land has not been considered.

Fencing may or may not be required, and, in any case, the cost would be the same for each line.

The following light railways have been estimated for :—

	WEIGHT OF RAILS, AND GAUGE OF RAILWAY.					
	Queens- land.	Barbadoes.	Cape Colony.		England.	Ceylon.
	35 lbs. 3 ft. 6 ins.	40 lbs. 3 ft. 0 ins.	45 lbs. 3 ft. 6 ins.	30 lbs. 2 ft. 6 ins.	60 lbs. 4 ft. 8 1/2 ins.	45 lbs. 5 ft. 6 ins.
	£	£	£	£	£	£
Survey .. ..	—	—	30	25	—	—
Engineering and super- vision .. ..	100	64	100	125	—	117·7
Land .. ..	—	222	80	—	150	28·0
Fencing .. ..	150	—	80	—	360	17·3
Earthworks .. ..	600	293	703	250	165	232·8
Bridges and culverts .. ..	640	225	752	250	300	469·5
Permanent way and ballasting .. ..	1418	1194	1736	950	1364	1326·0
Stations, buildings, etc. .. ..	60	70	324	50	50	106·6
Rolling stock .. ..	—	527	300	250	200*	162·3
Temporary work and sundries .. ..	110	125	170	100	111	98·1
Contingencies .. ..	—	—	—	—	—	179·2
Estimate per mile ..	£3078	£2720	£4275	£2000	£2700	£2737·5

Estimate of cost per mile of a light surface line of railway, with 60-lb. steel rails, by Mr. Price Williams.

PERMANENT WAY.

95 tons steel rails, 60 lbs. per yard ..	..	..	at £5	475	0	0
3·22 " fish-plates ..	..	..	at £8 16s.	28	6	9
0·65 " bolts (No. 1408) ..	..	..	at £16 6s. 6d.	10	12	3
2·80 " spikes (No. 7744) ..	..	..	at £13 8s.	37	10	3
1936 sleepers, 2 ft. 10 ins. centres, 8 ft. x 9 in. x 4 1/2 ins., at 2s. 6d. each				242	0	0
1760 lineal yards laying road ..	..	..	at 1s. 8d.	146	13	4
1200 cubic yards ballast, 6 ins. deep, under sleepers ..	..	..	at 5s.	300	0	0
				£1240	2	7
2200 cubic yards earthwork (forming) ..	..	..	at 1s. 6d.	165	0	0
Sidings, switches, crossings, etc. £1,240	10	..	..	124	0	0
Culverts, waterways, side drains, etc. ..	..	..	..	300	0	0
Station platforms, etc. ..	..	..	..	50	0	0
Land, 3 acres per mile ..	..	..	.. at £50	150	0	0
3600 lineal yards fencing and gates ..	..	..	..	360	0	0
				£2389	2	7
Locomotives, £2,000	10	..	..	200	0	0
Contingencies, 5 per cent., say ..	..	..	..	111	0	0
Total cost per mile ..	..	..	..	£2700	0	0

NOTE.—In this estimate, Mr. Price Williams has allowed nothing for Engineering, Promotion, or preliminary expenses.

\* Locomotives only.

The following light railways have been constructed:—

In India.\*

	WEIGHT OF RAILS, AND GAUGE OF RAILWAY.				
	Hyderabad, Umarkot.	Gaekwai's Dabhol.	Morvl.	Bickaneer section.	Tirhoot section.
	60 lbs. 5 ft. 6 ins.	30 lbs. 2 ft. 6 ins.	30 lbs. 2 ft. 6 ins.	40 lbs. 3 ft. 3½ ins.	40 lbs. 3 ft. 3½ ins.
Preliminary expenses .. ..	£ 44	£ 36	£ 14	£ 12	£ 40
Land .. .. ..	27	—	1	—	214
Formation .. .. ..	164	} 405	520	132	235
Bridgework .. .. ..	333				
Fencing .. .. ..	23	985	762	1105	1755
Permanent way and ballast .. ..	1036				
Stations and buildings .. ..	175	271	30	101	691
Plant .. .. ..	24	9	12	9	127
Rolling stock .. .. ..	9	271	278	181	675
General charges .. .. ..	866	148	92	17	299
Cost per mile .. .. ..	£2701	£2125	£1709	£1566·5	£5124

In Europe.\*

	WEIGHT OF RAIL, AND GAUGE OF RAILWAY.					
	Caen to Dives-en- Luc, France.	Pithiviers to Toury, France.	Belgium.	Corris, North Wales.	Clogher Valley, Ireland.	Wooton tramway.
	30 lbs. 2 ft. 0 ins.	19 lbs. 2 ft. 0 ins.	35 lbs. 3 ft. 3½ ins.	— 2 ft. 3 ins.	45 lbs. 3 ft. 0 ins.	48 lbs. 4 ft. 8½ ins.
Cost of construction ..	£ 1223	£ 2038	£ 1814	£ 3286	£ 1600	
,, rolling stock ..	2143	328	650			400
Total cost per mile ..	£2143	£1551	£2688	£1814	£3286	£2000

\* See also Chap. X.

In our Colonies.\*

WEIGHT OF RAIL, AND GAUGE OF RAILWAY.				
	South Australia.		Cspe Colony.	New South Wales.
	40 lbs. 5 ft. 3 ins.	40 lbs. 3 ft. 6 ins.	45 lbs. 3 ft. 6 ins.	4 ft. 8½ ins.
Cost of construction	£ 5000	£ 3548	£ 4700	£ 3708
„ rolling stock	—	—	—	161
Total cost per mile	£ 5000	£ 3548	£ 4700 †	£ 3869

In this country two light railways are being constructed, one on the standard gauge, from Castle Cary to Somerton (capable of carrying the Great Western rolling stock). There are to be no stations or signals, and the capital cost is to be £5000 per mile. The other railway is to run from Barnstable to Lynton, on a gauge of 2 feet. The capital cost is to be £3,660 per mile, but the cost of construction is estimated at £2614 per mile.

In India, a railway on the 2 ft. 6 ins. gauge, with 30-lb. rails, is under construction, from the Barsi Road Station of the Great Indian Peninsular Railway to the town of Barsi, a distance of nearly 22 miles. The capital cost of the line is £3,409 per mile, which is sufficient to provide for the complete and efficient construction and equipment of the line, including rolling stock, and to meet all preliminary expenses, and the payment of interest on capital during construction. The traffic on the railway is estimated at 70,000 tons of goods and 63,000 passengers annually, or 3182 tons and 2863 passengers per mile per annum.

\* See also Chap. X.

† Without rolling stock.

## CHAPTER VIII.

*WORKING EXPENSES.*

THE working expenses of railways depend upon several conditions, which vary on different railways. The length of the railway, and the quantity of the traffic, the gradients and curves, the cost of fuel and labour, all have a direct effect on the carrying cost, irrespective of the gauge of the railway; but, as has been previously stated, it is as economical to move a ton of goods or a passenger on a narrow-gauge railway as on a broad one, if like with like is compared.

Where the traffic is very small, not reaching more than £300 per mile per annum, the balance is more in favour of lines built in accordance with this traffic, both as to gauge and strength, than of others built to the standard of the main lines, or of lighter construction, to carry the main-line rolling stock without the engines. Whatever the traffic, there are certain standing charges to be paid, which will not vary to any great extent, whether the traffic is light or fairly heavy. The general management, the superior supervision, and station staff, will be the same for a light line as for a heavy one, with small traffic; but the expenditure in maintenance, both for labour and materials, will be greater on a line carrying heavy rolling stock than on one carrying light rolling stock for the same amount of traffic.

The usual expenditure for labour on maintenance of lines carrying the main-line rolling stock averages one man per mile of railway, whilst the same on lines of lighter construction is as low, in some instances, as 0.18 per man per mile. The haulage expenses and the shunting operations of lighter rolling stock will be additional items of economy, whilst the proportion of live paying load to dead load will be more favourable in the case of the lighter rolling stock.

On a line now working, 400 miles long, with a traffic of about £300

per mile per annum, the average freight load was only 2·49 tons in a vehicle capable of carrying 5 tons, and the percentage of freight to total weight on rails was 43·32 per cent. Had the main-line rolling stock of the country been employed for this traffic, the per centage of freight to total weight would have been about 33 per cent.

It has been stated that the standing expenses of light lines with small traffic, say under £500 per mile per annum, will amount to about £70 per mile per annum, and the working expenses will be this sum, with an addition of  $\frac{1}{3}$  of the receipts. That is, if the revenue of a line amounts to, say, £300 per mile, the working expenses may be expected to reach £70 + £ $\frac{300}{3}$ , = £170 per mile per annum, or, say, 56 per cent. of gross earnings. The train mileage per mile per annum for this traffic would probably amount to 3000 train miles, or nearly 1s. 2d. per train mile, as low a figure as may be expected to be reached in this country on any light railway, carrying passengers and goods traffic, unless under very special circumstances. If a line constructed for this traffic is to earn, say, 4 per cent. on its capital, after paying working expenses, the capital cost must not exceed £3000 per mile.

There are no light railways in this country, excepting perhaps one or two, which are worked at as low a figure, but which must be attained, if the railways are to be a financial success. The railways in the Isle of Man (see Chap. X. for details) are worked at 2s. per train mile, and earn 4s. 3d., but this is less than 50 per cent. of the receipts; whilst the locomotive charges, including cost of repairs, is only 5·75d. per train mile—

The Corris Railway is worked at 2s. 2d. per train mile, earning 3s. 2d.

The Easingwold      „      „      1s. 10d.      „      „      2s. 1d.

The Glyn Valley      „      „      1s. 7d.      „      „      2s. 9d.

The Golden Valley Railway, worked by the Great Western Railway Company, using the main-line waggons, but light engines and coaches, with a traffic earning 1s. 2d. per train mile, is worked at 1s. 8d. Compared with the other railways, this line is only charged with a proportion of the “repairs to waggons” and traffic charges.

The Wolverton and Stoney Stratford Railway is worked at 1s. 0d. per train mile.

The Wootton Tramway      „      „      8d.      „      „

The working expenses of the so-called light railways in Ireland vary from 1s. 5d. to 2s. 7d. per train mile.

The main results of working the light railways of Belgium is 10d. per train mile, or £204 per mile per annum, earning 1s. 2½d., or £286 per mile, and, on account of the very low rates charged—under 1d. per ton per mile—the expenses are 71·31 of the gross earnings.

Each line, or series of lines, is worked by a private company or firm, which provides all labour, fuel, etc., and executes all repairs both to the works and rolling stock. The agreements vary on nearly every line. The principal items are as follows:—

On the Ostend-Furnes line, the working company receives—

70	per cent. of all receipts up to £288 per mile per annum.
69	" " " £320 " "
68	" " " £352 " "
65	" " " beyond this sum.

On the Ostend-Blankenbergh the agreement is—

All receipts up to £128 per mile; 44·95 per cent. of all receipts up to £320 per mile, with a deduction of 0·1 per cent. for every additional £6·4 per mile above £320. The working company is guaranteed a minimum of £128 per mile by the National Society.

The details of the working expenses of local railways in other countries are dealt with in Chapter X., and particular attention should be given to the Palmerstone and Pine Creek Railway, in South Australia. This railway is worked at a cost of only £78 per mile, but giving only 214 train miles per mile per annum.

In comparing the locomotive expenses on a broad- and narrow-gauge railway, the statistics, furnished by the Locomotive Superintendent of South Australia, show good results in favour of light narrow-gauge railways for small traffic. As will be seen from Table S, the relative cost of consumption of coal and lubricants per 100 tons per mile is less on the narrow gauge than on the broad.

In New South Wales, the Lismore-Tweed line is worked at a cost of £84 per mile per annum, giving a train service of 607 train miles per mile per annum, or a train each way per day. The revenue is so very small, amounting to only £69 per mile per annum, that it is questionable whether any railway with this small amount of traffic, even of the simplest and most economical type, could do more than pay working expenses.

The working expenses on light lines in our colonies, with a train service of not less than 1200 train miles per mile per annum, should not exceed 2s. 6d. per train mile; but, of course, this will depend on many circumstances, and particularly on the length of the line, and also on its quality and type.

The ordinary daily run of a locomotive is about 100 miles, and, consequently, a line 50 miles long, or in multiples of 50, will be more economically worked than, say, one of 30 miles. The former will allow an engine to complete the double journey in one day, and, consequently, both men and plant are fully employed. Fixed charges will also be less per train mile the longer the distance to divide them over.

A well-constructed, well-ballasted and maintained little railway, with rolling stock in good order, will be more cheaply worked than the ordinary railway constructed for the sake of economy, with the secondhand rails, shaky rolling stock, and patched-up locomotives of the main lines.

Railways constructed for special traffic have been worked at a low cost per mile, and the following statistics will show what has been done on a railway in Brazil for sugar traffic.

The railway is 100 miles long, with branches, laid with rails 14 lbs. per lineal yard, and the total cost, including equipment, was £1263 per mile, or a total cost of £126,300.

The working expenses are:—

	Per mile per annum.						
	£						
Maintenance ...	...	...	...	...	...	...	5
Locomotive ...	...	...	...	...	...	...	16·3
Repairs to rolling stock	...	...	...	...	...	...	2·0
Management ...	...	...	...	...	...	...	37·0
Sundry charges	...	...	...	...	...	...	4·7
							£65·0

The gross earnings amounted to £225 per mile per annum. The working expenses are therefore 28·8 per cent. of gross earnings, and the net return on capital is 12·6 per cent. The traffic carried amounted to 45,000 tons.

## CHAPTER IX.

*THE FINANCING AND WORKING OF LIGHT RAILWAYS.*

IN the financing and working of light railways in this country and in our colonies, every precaution must be taken to ascertain that the railway has some future prospect of paying its way, and the following elementary rules must be observed :—

“ 1. The most careful possible estimate of earnings must be made, and without being turned aside by mirages, which lead not only County Councillors but also working Companies aside, we must resolutely refuse to have anything to do with lines where we cannot feel sure of immediate earnings of at least 50s. per mile per week. On general principles, we shall not be far wrong in assuming that a line which serves a district where there are manufactorys of some kind, and a dense population, will always pay its working expenses, whereas a line which has nothing but agricultural traffic will rarely cover its working expenses, unless it leads directly to an important town.

“ 2. We must get rid of all the unnecessary surplusage to which the main lines have too much accustomed us. Let the railway be as far as possible a high-road, and worked with the most strict economy. Do not demand three trains each way daily at the outset, as a matter of course. Almost all the places where light lines are asked for have at present only two connections by public vehicle each way daily, one in the morning and one in the evening. It would, therefore, be only reasonable for poor lines to only have two trains each way daily, which ought to satisfy the inhabitants by their additional speed and additional comfort. Later on, if the receipts increase, the Department may require a third train to be put on under conditions laid down to start with in the concession. If this be done, there will be little risk to fear insufficiency of receipts. Unfortunately it would be very difficult now to induce people who have got their light lines to consent to one of the existing trains being taken off, though in fact it may be practically empty.

“ 3. The number of locomotives required might be somewhat reduced, and there might be certain motor vehicles which, either alone or drawing a single carriage, could at certain hours give an additional service on the most populous portion of the line, such as the suburbs of a town.

“ 4. There should be some modification introduced into the requirement that there shall be for each Department a separate working Company, and a single working Company might be allowed to work the lines of two or more adjoining Departments

which are in similar conditions. In this manner the general expenses would be diminished, and also the cost of repairs." \*

In Great Britain it may be said that we have practically no light railways, and that all the railways have been built by private enterprise without the assistance of the State or of any local corporations. The competition here has been so keen amongst the great railway companies, that they have undertaken the construction of branch or feeder lines in districts where it was almost impossible for the traffic to do much more than pay working expenses, even if so much. These lines have all been constructed on the standard gauge, conforming in all respects to the Board of Trade requirements, and worked by the main-line engines and rolling stock.

There seems now to be a very strong movement in the country in favour of light railways in the interests of agriculture, and, if these railways are to be constructed, it is probable that the State and local bodies will have to assist in the financing of them. This has been done very considerably on the Continent, and if these light railways are to be a partial solution of the problem of agricultural depression, and the agricultural interest cannot pay for them, then the State must assist, or the railways will never be made.

There is no doubt that better communication between towns and villages must tend to bring more land into cultivation, and open up a wider area to a good market; and, if it is to the interest of the country as a whole, that more land should be brought into cultivation, it is surely the duty of the State to assist in providing the means of better communication.

Means of communication in the form of roads, bridges, and railways, are provided by Government in every colony; and, in countries over which we have established a protectorate, the State undertakes the whole burden of constructing and working the railways, necessary for the development of the country.

State and local assistance have been given to the railways in Ireland, and it may be said that nearly every railway in that country has, at one time or another, received some financial assistance from one or other of these bodies, and, up to the present time, a sum

\* *Transport*, Nov. 30th, 1894.

of nearly three millions sterling of Government money has been contributed to these railways.

Part of this money, to the extent of about one million sterling, has been advanced to the private railway companies as a loan, the security being a mortgage on the property. The remainder has been given out and out, without any Government control in the management, to the several railway companies, on their undertaking to construct and work certain railways.

The subsidy for these so-called light railways, under the Acts of 1889 and 1890, amounts to about £5000 per mile of railway, a sum which should have been more than sufficient to cover the whole cost of the railways per mile.

The private railway companies in Ireland are receiving at the hands of the State, not only a branch railway free of cost, but also all the new traffic which the branch railway collects and delivers to the parent line.

Another form of assistance given to these railways has been the Baronial guarantee of interest. In this case the Baronial authorities have guaranteed interest on the whole, or on part of the capital, at the rate of 4, and sometimes 5, per cent., either in perpetuity or for 30 years. In these cases the guaranteed companies manage their own affairs, whilst the Baronies have the power to appoint one or more directors on the board.

It is needless to say that these so-called light railways have not been a financial success, though they have contributed very materially to the improvement and welfare of the districts through which they have been constructed. The capital cost of the lines has been excessive, the financial arrangements have been on too lavish a scale, and have not contained in them the elements of commercial success, whilst the working expenses, under the Board of Trade regulations, and perhaps incompetent management, have been too high.

Agricultural lines, pure and simple, are not sufficiently remunerative to tempt the employment of private capital, and all experience on the Continent, with the exception of one or two instances, points to the association of the State and the local authorities with private enterprise, in the construction and working of these lines. Unless some such basis as this can be arranged for the light railways in

Britain, there is very little hope of many lines being built. With the Board of Trade regulations amended for a maximum speed of 20 miles an hour, instead of 70, as at present, and the preliminary negotiations necessary for obtaining authority for the construction of a railway simplified, and expenses reduced, there are districts in which light railways can be constructed without State or local aid, and which will not only pay their way, but return a fair percentage on their capital.

It will be a matter for arrangement whether these lines shall be constructed and worked by a separate company, or whether they shall be undertaken by the main-line companies, as is done in Ireland. The capital for these lines might be found by private individuals interested in the district, and, after construction, the line could be handed over to a main-line company to work at a fixed percentage of receipts, as is proposed to be done in one or two light railways now before Parliament. For a short isolated branch, this may be the best method, but the calculation of the receipts earned by the branch, should follow on the lines adopted for branch lines financed by private companies in India, as explained in Chapter X.

The branch line is entitled to a percentage of any increase of traffic collected and handed over to the main line, which traffic would not have been created had the branch line not been made. If a system of light railways, radiating from large towns or a good market, is decided upon—and these are the lines which will mostly benefit agriculture, and are most likely to be financially successful—it would be better to follow the system adopted in Belgium, and form a separate company for their construction and working.

If any lines proposed in a district do not show sufficient inducement for private enterprise to take up, the money for these should be raised by a guarantee of interest, shared by the State and the local authorities, the working company taking the risk of the line paying working expenses. The locality requiring the railway should take the initiative in promoting the railway, and be prepared to undertake a certain proportion of the guarantee of interest.

If a district is prepared to do this, the State can hardly refuse to supply the balance of the guarantee necessary for raising the capital. The localities and private enterprise being associated

together in the risk would prevent lines being undertaken without due consideration, or prospect of returning a fair interest on capital, after paying working expenses.

The guarantee of the State would enable the money to be raised without difficulty and at little expense, and would do away with those large financial swindles which have handicapped many lines already constructed. Even if the lines did not earn the whole of the guarantee, it can scarcely be said that the country would lose, as the undertaking would undoubtedly improve the condition of the people, and confer benefits on the districts which would not have been obtained otherwise.

Light railways, under this principle, should mean railways costing not more than £3500 per mile. For this sum, a line on the standard gauge can be built in a fairly easy country, whilst a serviceable line on the 2 ft. 6 ins. gauge can be constructed, and equipped, in almost any mountainous district.

The following are the principal modifications of the Standing Orders of Parliament, and the laws affecting the authorization and construction of light railways, proposed by Mr. Pain, in a paper read before the Surveyors' Institute, on February 18, 1895:—

“1st. One notice only of the intention to introduce a Bill to be required in a paper circulated in the district served by the light railway, one in a London daily paper, and none in the *London Gazette*, which the public never sees or reads.

“2nd. The Parliamentary deposit to be at the rate of  $2\frac{1}{2}$  per cent. on the cost of the works, instead of 5 per cent., as at present, and the promoters to be at liberty to deposit stock of the trustees' investment class.

“3rd. The scale of fees payable during the passing of the Bill through Parliament to be 50 per cent. less than that now in force.

“4th. The provisions under the Customs and Inland Revenue Act, 1889 (Mr. Goschen's), by which 2s. per cent. on the authorized capital has to be paid on the passing of the Act, to be repealed so far as regards light railways.

“5th. Power to be given in all Light Railway Acts to authorize the company to issue ordinary shares at a discount not exceeding 10 per cent., or to pay interest out of capital not exceeding 3 per cent. per annum during the construction of the line.

“6th. Power also to be given to issue debentures not exceeding one-half the amount of the ordinary share capital.

“7th. Power to be given to the company to compel parishes, or parts of parishes, to be benefited by the construction of the light railway, to make and levy a rate on all property, such rate to be determined by the valuer appointed by the Board of Trade, and to be equal to one moiety of the improved annual value arising from the opening of the light railway. No such rate to be levied until the light railway is

opened for traffic; and as soon as 3 per cent. has been earned on the ordinary stock from the net traffic receipts, and paid for three consecutive years, the power to rate the parish to cease. The maximum amount in the £ of the rate to be levied to be fixed in the Bill by Parliament after having received a report on the same by the valuer appointed by the Board of Trade.

“8th. Acquisition of land. The powers of the Board of Trade under the 85th section of the Lands Clauses Act to appoint a valuer for immediate possession to be extended, so as to constitute such surveyor or valuer the official umpire in all cases of disputed compensation between the company and those beneficially interested in the property to be acquired.

“9th. Power to be given to the company, in all cases where the compensation exceeds the sum of £100, to give a rent-charge in place of such money payment of compensation, such rent to be based on the 3 per cent. tables.

“10th. Powers of the Board of Trade to be further extended as follows:—After the passing of an Act, but before the commencement of the construction of a light railway, working plans and sections, with a specification of the works, to be deposited by the company's engineer with the Board of Trade, who shall state, in writing, what relaxation of the usual requirements will be permitted under the particular circumstances of each case, under the following heads:—Description of Permanent Way; Signalling at Junctions and Stations; Length and Height of Passenger Platforms, if any; Accommodation at Stations for Passengers; Gate-keepers' Huts at Level Crossings; Speed of Trains, and Description of Rolling Stock.

“11th. Power to be given to the Board of Trade to permit the company to use materials which have been used before, but which are in a thoroughly sound condition, such as rails, sleepers, fastenings, fencing, gates, girders for over and under bridges, station buildings, or other materials which the company's engineer shall declare, in writing, are fit and proper to be used for the purpose.

“12th. Light railways not to be subject to the clauses in the Regulation of Railways Act, 1889:—1st. As regards mixed trains; 2nd. As regards continuous brakes, except in cases where the gradients are so long and severe that, in the opinion of the Board of Trade inspector, it would be dangerous to work the trains without them.

“13th. No passenger duty to be paid by a light railway company.”

#### FINANCING AND WORKING LIGHT RAILWAYS ON THE CONTINENT.

“On account of the direct or indirect advantages accruing from contributive lines to the communes, the State and the nation, the intervention of corporate bodies by means of subsidies, advances or guarantees of interest, is justified, both by reason and experience.

“This intervention is, moreover, a necessary condition of existence for these lines.

“The subscription for ordinary shares on the part of the communes, as in Austria or, in another shape, as in Belgium, appears to be the most logical method, for it is in conformity with considerations of abstract justice; first, because the sacrifice should be only temporary, since the development of traffic should render it unnecessary later on; and secondly, because corporate or associated bodies which are indirectly interested in the existence of the line, independently of the direct advantages they gain, should fairly give preferential interest in return, to private parties working the line who have spent time, trouble, and money upon it.

"I do not advocate that the great companies should supply capital. This generally induces a false position, and produces too great dependence of the little line, and is unprofitable both to the company working the line and to the public.

"I am not here criticizing lump-sum grants, or subscriptions for deferred shares.

"The leasing of contributive lines constructed entirely by the great lines, or taken over by them, on condition of leaving the lessee sufficient liberty and ample return on capital expended, and capability of grouping the lines so as to decrease general expenses, seems to me preferable. The foundation of special companies to undertake the construction and working of light lines tributaries to main lines, with the assistance of the great companies to assist or help in the working, seems to me the most logical, complete, and, financially speaking, the most favourable method, if the assistance is ample and genuine. Working under these conditions will be more economical than if great companies worked the lines directly, and there should be preliminary agreements duly defined, and fixed rules as to the method in which the great companies should assist the smaller ones.

"Indirect subsidies, such as granting land, allowing the stations, shops, etc., to be used, seem to be the rule everywhere; these are reasonable, and ought to be obligatory, if only in the public interest. They should never become a handle for high-handed oppression on the little line, or a source of profit out of proportion with the sacrifice entailed.

"They may also result in making the little lines share in expenses and methods of working incompatible with the economy which should prevail. However, day by day, relations are becoming more cordial with the main lines; distrust is tending to disappear, and the burdens laid on the little lines are losing their appearance of exaction and unjustifiable indirect taxation.

"The public authorities will soon compel main lines to bear the cost of joint establishment.

"The payment of a bonus by the great line to the little line per passenger or per ton brought on to their line, or on the total of new earnings gained at the junction, seems the fairest and most precise method of subsidizing light lines. M. Considère's investigation shows this method to be actually only fair, and the companies who have applied it have certainly gone in the right and most liberal direction.

"In goods traffic, connecting service is necessary, but I advocate the method of re-booking, simplifying the formalities between the companies, and giving up through service, even when the gauge is the same. For the secondary lines, through booking is a useless burden and expense, without being of any real advantage to the public. Through service requires or results in the entire adoption of all the rates, classifications, formalities, regulations, and account-keeping systems as carried out on the great lines.

"The principle of absolute simplification and of economy which ought to be the essence of the organization of a local or secondary line, the limited staff, the avoidance of clerkage, the absolute simplicity of rates and audit; all this is destroyed by copying main lines, and replaced by complicated machinery which the main lines have been obliged to build up owing to the extent, complexity, and even internationality of their services. These reasons are exactly those which do not exist for light contributive lines.

"To apply the ordinary rates to light lines is anomalous, but if the services are carried out jointly with the main lines, they become almost absolutely necessary. This is an anomaly, because classification has but little importance for lines of short

length, as was the case with cartage; the weight, space occupied, and manner of packing are almost the only things to consider; moreover, the ratio between the mileage rate and terminals is inversely proportionate for the little and big lines; for the short contributive lines the constant element is of primary instead of secondary importance. If light lines are, so to speak, to be squeezed into the mould made for the main lines, the result will be that they will come out misshapen, and their growth will be stunted.

"In order to give the public the same advantages, the connecting service requires, on the part of the main systems, a simplified and liberal organization, the reduction of formalities required for re-booking, and regulations which still have to be investigated; but when the main lines choose, agreement will be established without difficulty.

"All methods of transhipment belong to this part of the subject. The organization of stations where the lines meet with methods of transhipment, loading and unloading worked completely by mechanical power, and acting rapidly, still require completion if not actual invention. The realization of this requirement appears to be the first step necessary to allow of the connecting method gaining the upper hand.

"The actual passage of rolling stock from the main line on to the secondary lines is a burden which, from the time of equipping the line, encroaches upon the principle of economical construction. It would be advantageous never to expect this; and on this account, were it the only advantage, it seems to me that narrow gauge ought always to be adopted for contributive lines.

"Transhipment of goods is represented as a bugbear. This is a heresy that ought to be extirpated. Everybody knows that even where there is no need for transhipment, transhipment is carried out all the same, and to a considerable extent.

"My report has placed side by side what is required and what has been attained. As a matter of fact, there exist everywhere modest attempts at help or assistance on the part of great companies. Nevertheless, reserve and hesitation in granting it are the usual rule.

"Many favours are only apparent, although held out as advantages generously conceded.

"At any rate, we can assert that no recognized method of assistance is adopted in practice.

"The great companies, if they will be less dictatorial, will find their relations with their tributaries daily more active, and more close to the great benefit not only of both sides but of the public."\*

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\* Report to the International Railway Congress, London, 1895. By M. H. de Backer, General Manager of the General Economic Railway Society (Belgium).

## CHAPTER X.

*LIGHT RAILWAYS OF OTHER COUNTRIES.*

IN this chapter are collected statistics of railways in several countries, which may be considered the light railways of those countries, and a perusal of this information will show in many instances why the net revenue does not suffice to pay interest on the capital expenditure. The information may also be of service in determining what type of railway should be laid down to suit certain conditions in any district.

“The rapid growth of interest,” says the *Railway World*,\* “in the development of light railways, among both officials and the general public, has, however, drawn marked attention to the possibility of using a narrower gauge than that generally adopted as a standard, for the lines intended as feeders to main routes where some economy in land, construction, work, or material, may conceivably result from such a course. It is, therefore, of no little interest to see what is being done in foreign countries in the direction of narrow-gauge lines; though, of course, other considerations than those which are merely technical must govern the adoption of such railways for this country, where financial and social conditions may be in this respect quite different. Still, speaking generally, there are many cases in Great Britain where the use of a narrow-gauge system at least merits careful consideration, unbiassed by the fact of an already fixed standard.”

## ENGLAND AND WALES.

In the **Isle of Man** there are about 46 miles of railways, and the railway taken here as an illustration runs from Douglas to Castleton and Port Erin to Peel. The lines have been substantially constructed, and the capital cost amounts to £9875 per mile.

The traffic is chiefly passengers, with a large tourist traffic in the

\* March, 1895.

summer, when as many as twelve trains each way per day are run. The railway is worked on the staff system, the trains are *not* fitted with continuous brakes, signals are *not* used except in a very primitive fashion, there are no platforms at the stations, and all the usual requirements of the Board of Trade are conspicuous by their absence. Yet with a traffic of 640,000 passengers and 22,000 tons of merchandise per annum, and passenger trains running with sixteen coaches at the rate of 30 miles an hour, there are no accidents.

Labour and materials were high in price when the railway was built in 1873, hence the cost of the works is higher than it otherwise would have been.

The railway returns 5 per cent. on its fairly large capital.

The gauge of the line is 3 ft.

The rails weigh 40 lbs. per lineal yard.

The steepest gradient is 1 in 65.

The sharpest curve is 10 chains radius.

The locomotives have a single bogie in front, weigh 18 tons, and take 15 coaches, with 360 passengers, up the steepest incline.

The goods waggons weigh 2 tons 12 cwts., and carry 6 tons ; whilst the passenger carriages are of the ordinary type. The details of the revenue and working expenses per annum are as follows :—

Revenue—		£
Passengers	...	20,767
Parcels, horses, carriages	...	1875
Mails	...	325
Merchandise, minerals	...	2975
Rents, etc.	...	394
Transfer fees	...	7
Total revenue	...	£26,343

The number of passengers carried per annum is

648,779

The tonnage of merchandise carried per annum is

22,794

The working expenses—

Maintenance, locomotive, and all charges	...	£12,446
--	-----	---------

Rates, taxes, and law charges	...	182
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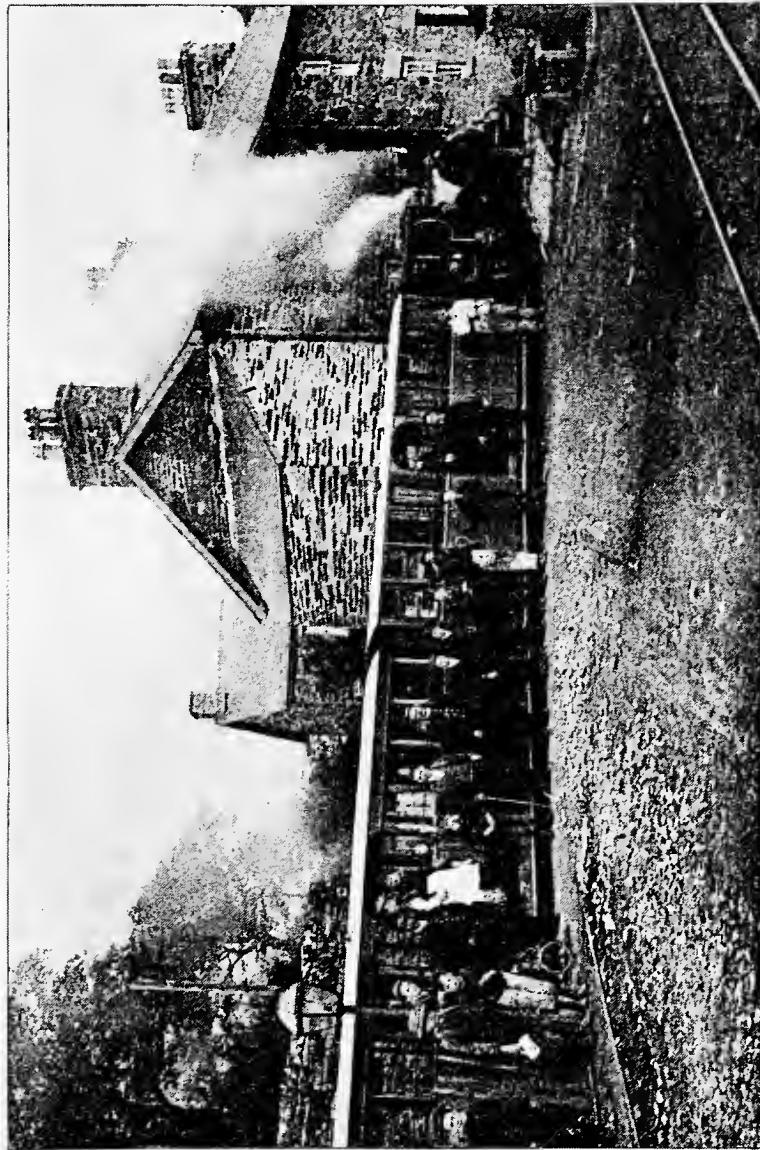
Compensation and losses	...	3
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Total working expenses	...	£12,631
------------------------	-----	---------

Revenue per mile = £976, and per train mile 4s. 3d.

Working expenses , = £468, , , 2s. 0d.

PLATE XIV.



FROM A PHOTO. BY J. THOMAS, LIVERPOOL.

CORRIS RAILWAY. GAUGE 2 FT. 3 IN.

INK-PHOTO SPRAGUE & CO. LONDON

[Between pp. 90 and 91.]



**The Corris Railway** (see tables E and F) is one of the most successful of the small railways in Wales. It has been constructed at a reasonable cost, and is economically worked, considering the gradients on the line. It pays 6 per cent. on its capital, and affords an excellent example of what the local railways intended for the benefit of agriculture in this country should be, if they are to pay their way financially. (Plate XIV.)

**The Easingwold Railway** (tables E and F) is a light railway on the standard gauge, and yet, with a traffic per mile much greater than the previous railway, only contributes 1·1 per cent. towards the interest on its capital.

**The Southwold Railway** (tables E and F) runs from Halesworth Station on the Great Eastern Railway to Southwold on the east coast. It has been the means of very materially developing this district, for whereas formerly an omnibus running at irregular intervals carried all the traffic, this now amounts to 87,000 passengers, and 9000 tons of goods annually.

Owing to the regulations imposed by the Board of Trade, and probably also to financial operations, the cost of the line has been unnecessarily high, the working expenses increased, and consequently very little towards the payment of a dividend is earned.

Regarding the evils of transhipment, of which so much is made, the people prefer to tranship their coal from the main-line waggons into those of the narrow gauge, send it along the small railway, and then cart it three quarters of a mile, rather than cart it in the first instance three miles from the main-line junction.

**The Festiniog Railway** has been constructed for a special traffic, which is mostly with the gradient, and enjoys a revenue per mile greatly in excess of anything that may be expected to be obtained, from a purely agricultural line.

With a capital cost of £10,727 per mile, it earns a dividend of over 5 per cent., and is an excellent example of what can be done on a 2-ft. gauge railway. The line is excellently managed, and may be considered the pioneer of narrow-gauge railways.

The locomotives are powerful little machines, and are capable of

doing excellent work. The double-bogie Fairlie engines weigh 24 tons in working order, and carry 700 gallons of water and  $1\frac{1}{4}$  ton of coal. These engines are used mostly for working the mixed passenger and goods trains, and are very satisfactory. They consume on an average 15 lbs. of coal per mile, and haul a gross load of about 120 tons up a gradient of 1 in 80.

There is a large tourist traffic on the line, and also a special traffic in workmen employed in the quarries. The charge for a workman's weekly ticket for the whole distance is only 2s. 4d., about 350 men being conveyed daily. On Saturdays and Mondays, some of the workmen's trains convey 700 men, and, at holiday times, as many as 1000 passengers have been conveyed in one train. The slate traffic is not so great as formerly, owing to the London and North-Western and Great Western Railway Companies having run their lines into the district.

The rate for slates is 2d. per ton per mile, and the passenger fares are as follows :—

1st Class.	2nd Class.	3rd Class.
2½d.	2d.	1½d. per mile
60 per cent.	60 per cent.	40 per cent., additional for return fare

The railway is well equipped with a complete system of interlocking; the trains are worked by the staff and ticket. The average speed is about 15 miles per hour, though a speed of 35 miles an hour has been run. The station yards and buildings provide everything needed for a well-equipped railway.

The transhipment is carried on as follows: miscellaneous goods and merchandise are dealt with in sheds, being unloaded from broad-gauge to narrow-gauge trucks, and *vice versa*, by hand. Coal is transferred by tipping the contents of the broad-gauge trucks into the narrow-gauge trucks by means of a special apparatus. Slates are either conveyed in their own small trucks, loaded on the broad-gauge trucks—three to a truck—or are transferred by hand. To facilitate operations, the rails of the respective gauges are either



FROM A PHOTO BY J. THOMAS, LIVERPOOL.

FESTINIOG RAILWAY. GAUGE 1 FT. 1½ IN

INN PHOTO SPRAGUE & CO LONDON





FROM A PHOTO BY J. THOMAS, LIVERPOOL.

FESTINIOG RAILWAY. GAUGE 1 FT. 11½ IN.

INK PHOTO SPRAGUE & CO LONDON





NORTH WALES NARROW GAUGE RAILWAY. GAUGE 1 FT. 11 $\frac{1}{2}$  IN.

*Between p. 92 and 93.*

INK PHOTO SPRAGUE & CO. LONDON



raised or lowered to bring the platforms of the trucks level with each other.

The earthworks on the line are very heavy ; there are numerous bridges and retaining walls, and also a tunnel 700 yards long.

The cost for maintenance, for labour only, amounts to £35 per mile per annum. (Plates XV. and XVI.)

**The North Wales Narrow Gauge Railway** has a large capital, due to the way in which it was financed. The actual cost of construction and equipment could not have exceeded £3500 per mile. This railway runs from Dinas, near Carnarvon, to Snowdon. (Plate XVII.)

**The Golden Valley Railway** is a purely agricultural line, built on the standard gauge, and running from Pontrilas to Hay, in the counties of Hereford and Brecon. It is worked by the Great Western Railway Company. The passenger carriages are of light construction, but the ordinary rolling stock of the main-line company conveys the goods traffic. The traffic is very scanty, amounting to only £111 per mile per annum, which is not sufficient to cover the working expenses.

With all the so-called advantages of being managed and worked by the main-line company, using the main-line rolling stock (for which no charge for repairs, etc., appears in the accounts), and debited with small traffic charges, the working expenses amount to 1s. 8d. per train mile.

**The Manchester and Milford Railway** runs through an agricultural district in the county of Carmarthen.

**The Wisbeach and Upwell Railway** is a light line  $5\frac{3}{4}$  miles long, on the standard gauge, owned and worked by the Great Eastern Railway Company ; it is laid with flat-bottom rails, weighing 55 lbs. per lineal yard. A guard rail of angle iron is laid throughout the whole length. No bottom ballast is put down, but a top dressing of ballast is used. There is no fencing alongside the public road, on which the line runs, neither are there any stations or telegraph.

The gradients are generally 1 in 100, but 1 in 30 inclines for short distances are introduced, where the line crosses over ordinary bridges.

The engines have four wheels, sheeted on the sides as in tramway engines, with wheel-bases of 6 ft. 6 ins. They carry 450 gallons of water, 15 cwts. of fuel, and weigh in working order 20 tons. The consumption of coal is 15 lbs. per mile, and the gross load taken by the engine is 65 tons, exclusive of the engine.

The passenger carriages used on the line are similar to ordinary tramcars, and the goods waggons are those running on the main line.

The average speed of the trains is eight miles an hour, and the maximum speed ten miles, but the speed has to be considerably reduced when passing the worst curves of three chains radius, and the truck wheels grind very badly in passing round them. The railway successfully competes with the canal as between Wisbeach and Upwell.

The train service is confined to week days only. Seven passenger trains and three goods trains are run each way daily. Trains stop anywhere to pick up and set down passengers, and the line is worked similarly to a street tramway.

The traffic for 1894 amounted to 103,966 passengers, and 33,385 tons of goods and minerals.

The first-class fare is at the rate of three-farthings per mile, the third-class one halfpenny, and the guard gives out the tickets in the train.

The train mileage per mile per annum	...	...	6000 miles.
The passengers carried	„	„	18,081 No.
The tonnage of goods	„	„	5806 tons.

**The Glyn Valley Tramway** was originally constructed as a horse tramway, but was not a financial success. It was opened as a steam tramway in 1888, and last year carried upwards of 20,000 passengers and 45,000 tons of goods and minerals. The line is 9 miles long, starting from Chirk on the Great Western Railway, and running along the roadside to Glyn. The traffic is mostly stone for road repairing purposes, and slates from the quarries. There is also a considerable tourist traffic in the summer, 300 passengers being conveyed in a single train.

The engines have  $10\frac{1}{2}$  ins. cylinders, 16-in. stroke, and the cost of haulage, including all charges for fuel and wages, is  $1\frac{1}{2}d.$  per ton per

mile. The cost of an engine working, including engine driver's and fireman's wages, cleaning, coal, oil, water, and all charges, amounts to £13 per week. The engines cost £1200 each.

The waggons, holding from 1 to 4 tons each, cost from £15 to £22. The coaches, open, seating 10 passengers, cost £60 each, and closed, £88 each.

## LIGHT RAILWAYS.

## SOME SECONDARY LINES OF RAILWAY, ETC., WHICH ARE OR HAVE BEEN OPENED IN GREAT BRITAIN, ARRANGED IN THE ORDER OF COST PER MILE.

NOTE.—The cost per mile is arrived at by dividing the paid-up capital by the length of line, and is, therefore, only approximate.

Name of Line.	Locality.	Approximate capital per mile.	Gauge.	Length.	When opened.	Remarks.
Wotton Tramway ..	Quainton Road to Brill, in Buckinghamshire	£ 1400 without land.	ft. ins. 4 8½	miles cbs. 8 (also to farm 1 m. 4 cbs.)	1872	Constructed by Duke of Buckingham, who gave his land and leased the rest; crossing roads by arrangement; rails, 48 lbs. per yard. No passenger stations, but carries passengers. Reconstructed in 1894, making total cost in 1894 £4000 a mile.
Corris .. .. ..	Machynlleth to Abergavenny	1814	2 3	11 0	1858	Line carries over 20,000 tons and 67,000 passengers, annually. Locomotives allowed 1864 (at 10 miles an hour). 1883 Act increased speed to 15 miles per hour. No accidents.
Mr. Pike's property ..	Obina Clay Mines to Poole	—	2 8	3 20	—	Fifty years old; five highway crossings; no gates. Speed about 15 miles per hour. Three slight accidents to animals, and one suicide. Not used for passengers.
Tal y llyn .. .. ..	Towyn to Abergynolwyn	2143	2 3	6 51	1866	Limit of speed by Board of Trade Order, 10 miles per hour. No accidents.
Torrington and Marland (Light)	Between these places to L. and S. W. station	2500	3 0	8 0	1881	Made by the Marland Brick and Clay Company. Freight only. Consent of all landowners was given. L. & S. W. estimate for a broad-gauge line was £30,000 per mile. Carries 20,000 tons per annum; can carry 100,000. One fatal accident.
Alford and Sutton Tramways	Alford (G. N. R.) to Sutton	2571	2 6	7 4½	1854	Closed and abandoned.
Van .. .. ..	In Wales	3788	4 8½	6 40	1874	Not passenger. No accidents.
Mawddwy .. .. ..	Cemmes Road to Dinas Mawddwy	3793	4 8½	6 60	1888	One accident.
Ravenglass and Eskdale	Ravenglass to Boot, in Cumberland.	4571	3 0	7 0	1873	No accidents.
Wantage Tramway ..	Wantage Road (G. W. Railway) to Wantage.	4800	4 8½	2 27½	1875	Passenger vehicles are tramcars. One man killed since opening. Partly along highway. Made under Tramway Act, 1870. No platform, except at Wantage. Speed limited to speed of Tramway Act. Rails, 46 lbs. per yard. Takes G. W. R. trucks.

Killin Railway .. ..	From the Callander and Oban Railway at Killin Junction to Killin on Loch Tay	5325	4 8½	6 6	1885	Constructed by Killin Railway Company, under Board of Trade Certificate of 7th August, 1885; worked by the Caledonian Railway Company with ordinary rolling stock and special engines; rails, 60 lbs. per yard; 1760 sleepers per mile. Two stations for passengers and goods.
Wisbech and Upwell ..	Wisbech (G. E. R.) to Upwell	5408	4 8½	7 6½ (includin- g 2 miles of siding.)	1883-84	Made and worked by G. E. R. Maximum speed eight miles an hour. Eighteen accidents since opening; four fatal. Partly along highways.
Portmadoe, Croesor, and Beddgelert, "Tram" Railway Company	Portmadoe to Croesor	5700	2 0	5 0	—	? Not working by steam.
Shailbeach District ..	Near Shrewsbury	6154	2 4½	3 26	1877	No passenger. No accidents.
Easingwold ..	Aine (N. E. R.) to Easingwold	6303	4 8½	2 37	1891	A "light" railway. No accidents.
Calm Valley ..	Tiverton Junction (G.W.R.) to Hem-yock	6620	4 8½	7 0	1876	Rails, 40 lbs. per yard; two intermediate stations; made under special Act (subject to 1868 Act); worked by G.W.R. at 50 per cent. until taken over by that Company. Speed by Act limited to 20 miles per hour. Takes G. W. R. trucks.
Glyn Valley Tramway ..	In Denbighshire	7311	2 4½	8 60	1870	Along Glyn Valley from G. W. R. Northern section. Rails, 50 lbs. per yard. Conveys from 20,000 to 25,000 passengers and 40,000 tons per annum. Speed limited to 8 miles per hour. Runs along highway for 5 miles. Four slight accidents. Formerly worked by horse power, but was reconstructed as a steam tramway in 1888.
Wainfleet and Kirby ..	In Lincolnshire	7195	4 8½	4 20	1871	Worked by G. N. R. No accidents.
Minehead ..	—	7272	4 8½	8 20	—	
Southwold ..	Halesworth (G.E.R.) to Southwold	8500	3 0	8 60	—	
Lee-on-the-Solent ..	Near Gosport	8779	4 8½	3 10	1894	Partly made under the 1868 Act for facilitating light railways. No accidents.
Festiniog .. ..	Portmadoe to Duffws	10727	1 11½	14 20	1836;	Railway; horse
					locomo- tives, 1863; For pas- sengers, 1865.	trams by Board of Trade; this restric- tion was withdrawn in 1870.

TABLE E.  
LEADING PARTICULARS, CAPITAL, AND COST OF CONSTRUCTION OF SOME RAILWAYS IN ENGLAND AND WALES.\*

NAME OF RAILWAY.							
	Corris.	Easing-wold.	South-wold.	Festiniog.	North Wales.	Golden Valley.	Manchester and Milford, Liskeard, and Caradon.
Gauge	2 3	4 8½	3 0	1 11½	4 8½	4 8½	2 4½
Length	11	2½	9	14	41	22	8½
Weight of rail per lineal yard	..	..	..	50	12	—	50
Steepest gradient	..	..	..	36 & 41	72	—	—
Sharpest curve	..	..	..	60	—	—	60
Maximum speed per hour	..	..	..	100	198	—	—
Cost per mile (including rolling stock)	1,814	6,309	8,500	30	16	30	66
" (rolling stock only)	..	..	..	10,727	10,434	17,617	8
Interest paid per annum on—				—	—	—	7,311
Ordinary stock	6½	nil	nil	4	nil	nil	900
Guaranteed "	..	..	..	—	—	—	—
Preferential "	..	..	..	4½ & 5	nil	nil	—
Loans "	..	..	..	5 & 4	nil	nil	5
Debenture ,	..	..	..	4 & 4½	—	4½ & 5	4½
Capital raised—				4 & 5	5	—	—
Ordinary stock	15,000	11,772	39,910	86,186	65,975	106,723	23,625
Guaranteed "	..	..	..	..	..	..	24,295
Preferential "	..	..	..	..	..	..	—
Loans "	..	..	..	..	..	..	—
Debenture ..	..	4,950	—	26,270	14,000	41,840	159,000
	"	"	"	..	..	..	—

\* Board of Trade returns.

TABLE

## REVENUE AND WORKING EXPENSES OF SOME RAILWAYS IN ENGLAND AND WALES.

NAME OF RAILWAY.										
	Corris.	Easing-wold.	South-wold	Festiniog.	North Wales.	Golden V. A. ley.	Manchester and Milford.	Liskeard and Caradon.	Glyn Valley.	
Receipts per mile, passengers ..	£ 117	331	277	457	193	71	264	25	55	
,, " goods ..	218	355	111	790	157	40	226	138	363	
,, " sundries ..	20	18	18	24	2	—	6	5	4	
Gross earnings per mile ..	355	704	406	1271	352	111	495	168	422	
Working expenses ..	245	618	336	697	310	157	439	162	244	
Net earnings per mile ..	110	86	70	57	42	—	56	6	178	
Gross earnings per train mile ..	3 2	2 1	2 5	3 6	2 8	1 2	3 5	5 0	2 9	
Working expenses ..	2 2	1 10	2 0	2 0	2 4	1 8	3 0	4 10	1 7	
Net earnings per train mile ..	1 0	0 3	0 5	1 6	0 4	—	0 5	0 2	1 2	
Working expenses of gross earnings ..	69	88	55	88	143	88	96	96	58	
Net return on capital ..	6 0	1 1	0 8	5 3	0 4	—	—	—	3 6	
Maintenance ..	£ 45	725	974	867	853	554	1553	574	297	
Locomotive power ..	39 5	185 5	86 0	160 0	87 0	28 6	123 2	35 9	84 7	
Repairs and renewals of waggons and coaches ..	18 3	3 5	17 0	10 7	30 7	7 0	26 8	9 4	27 0	
Traffic charges ..	113 1	220 0	95 3	212 4	69 0	20 9	81 2	37 8	43 5	
General ..	81 1	44 0	36 3	68 4	29 0	15 9	32 4	4 4	36 2	
Other charges, and legal and parliamentary ..	11 0	92 5	4 0	68 0	9 0	30 0	20 1	17 1	25 5	
Maintenance ..	pence 4 9	2 7	6 96	2 91	7 76	6 95	12 89	20 46	2 34	
Locomotive power ..	4 3	6 8	6 14	5 37	7 92	3 60	10 20	12 80	6 33	
Repairs and renewals of waggons and coaches ..	2 0	0 2	1 20	3 43	2 79	0 88	2 22	3 35	2 12	
Traffic charges ..	12 0	7 9	6 82	7 14	6 28	2 62	6 72	13 48	3 42	
General ..	1 9	1 6	2 6	2 3	2 64	2 0	2 69	1 56	2 85	
Other charges, and as above ..	1 0	3 0	0 28	1 0	3 76	1 66	6 10	1 86	—	
Passengers carried ..	No. 67,479	48,136	87,252	150,921	55,548	44,891	181,169	24,789	20,910	
Tonnage of goods and live stock ..	tons 20,244	12,517	9,033	131,670	11,811	8,121	52,310	18,833	45,182	
Passengers carried ..	No. 6,134	21,568	9,694	10,781	4,629	2,363	4,418	1,126	2,323	
Train mileage per annum ..	tons 1,840	6,258	1,004	1,484	1,427	1,276	856	5,015	5,015	
,, ..	2,207	6,657	3,350	7,141	2,637	1,912	2,897	673	3,049	

## IRELAND.

(PLATES XVIII., XIX., XX., XXI.)

The so-called light railways of Ireland, authorized under the Light Railway Acts, 1860 to 1883, have been constructed in a very substantial manner, and have cost, fully equipped, from £3200 to £8700 per mile. The general cost is from £5000 to £6000 per mile.

The permanent way consists of rails 45 lbs. per yard, 24 ft. long, fastened to wooden sleepers, 6 ft.  $\times$  8 ins.  $\times$  4 ins., by clips and fang-bolts, or by ordinary spikes, with an iron sole-plate between the rail and the sleeper. The formation width is 12 ft., the ballast width 8 ft., with 4 ins. in depth under the sleeper. Gradients from 1 in 30, and curves of 5 chains radius are not uncommon, and in a few instances curves of  $3\frac{1}{2}$  chains radius have been put down. The maximum speed is about 30 miles an hour.

The railways are well and substantially built in every way, and thoroughly equipped with signals, fences, telegraphs, etc., worked under the regulations of the Board of Trade, and in all respects similar to the main lines.

The locomotives are 4- and 6-wheel-coupled tank engines. The four-wheel coupled have a pair of radial wheels at the trailing end. They carry 550 gallons of water, 15 cwts. of coal, and weigh, in working order, 22 tons. Their gross working load up the steepest gradient is 60 tons, exclusive of weight of engine. The wheels are 3 ft. diameter, with a fixed wheel-base of 6 ft. 10 ins. The six-wheel-coupled engines carry 450 gallons of water, 1 ton of coal, and weigh, in working order, 24 tons. Their gross working load up the steepest gradient is 90 tons, exclusive of engine. The wheels are 3 ft. 2 ins. diameter, with a fixed wheel-base of 12 ft.

Compound engines are used on some of the lines, of two cylinders, with four wheels coupled, and a single bogie wheel in front and rear. The coupled wheels are 3 ft. 10 ins. diameter, with a fixed wheel-base of 6 ft. They carry 700 gallons of water, 1 ton of coal, and weigh, in working order, 31 tons. The gross working load is 90 tons, exclusive of engine, and the coal consumption is about 4 lbs. per mile less than in the ordinary engines, or 20 lbs. per mile.

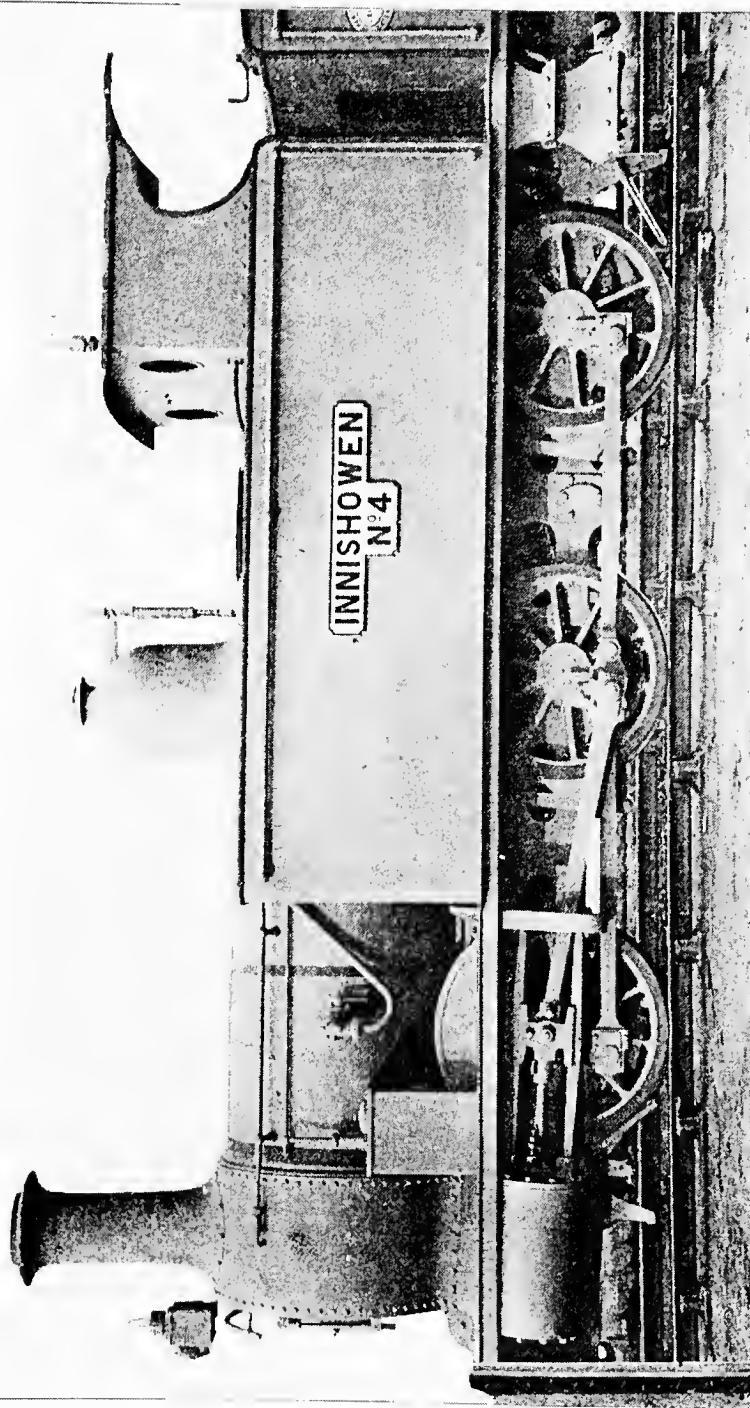


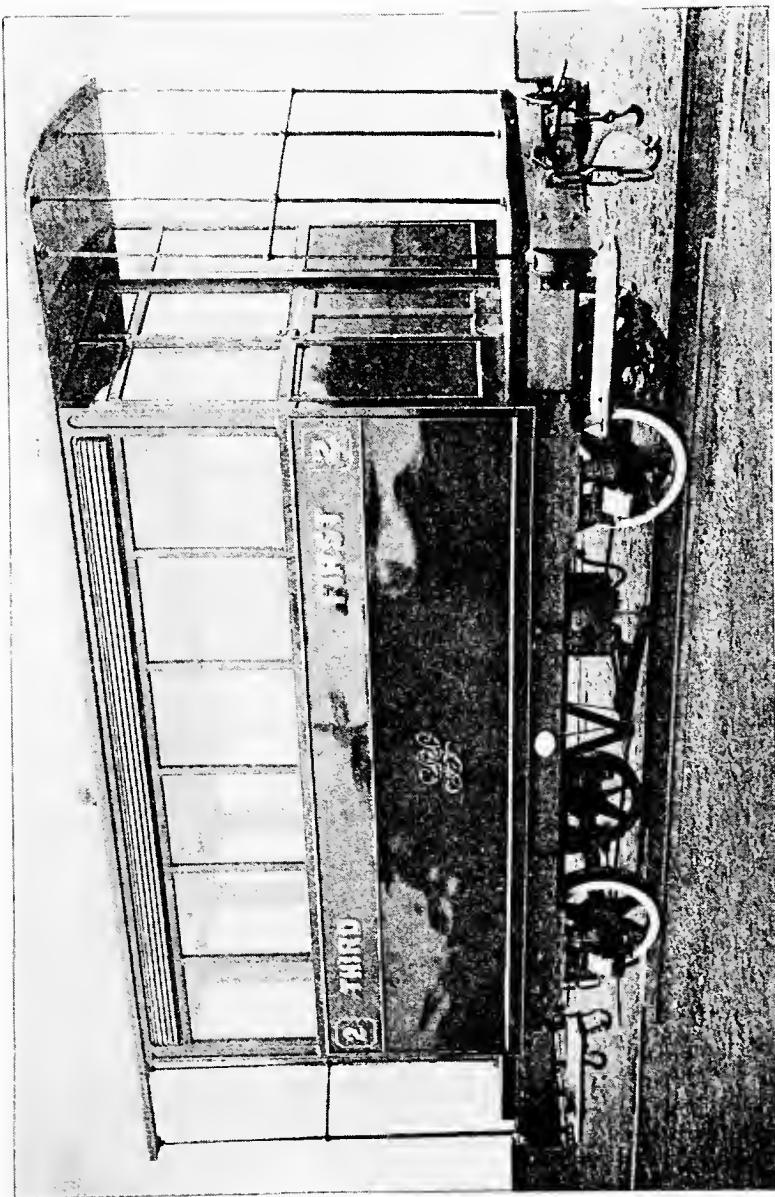
PHOTO FROM BLACK, HAWTHORN & CO

IRISH LIGHT RAILWAYS

IMPACTO SPRAGUE & CO LONDON

1 Between p. 100 and 101



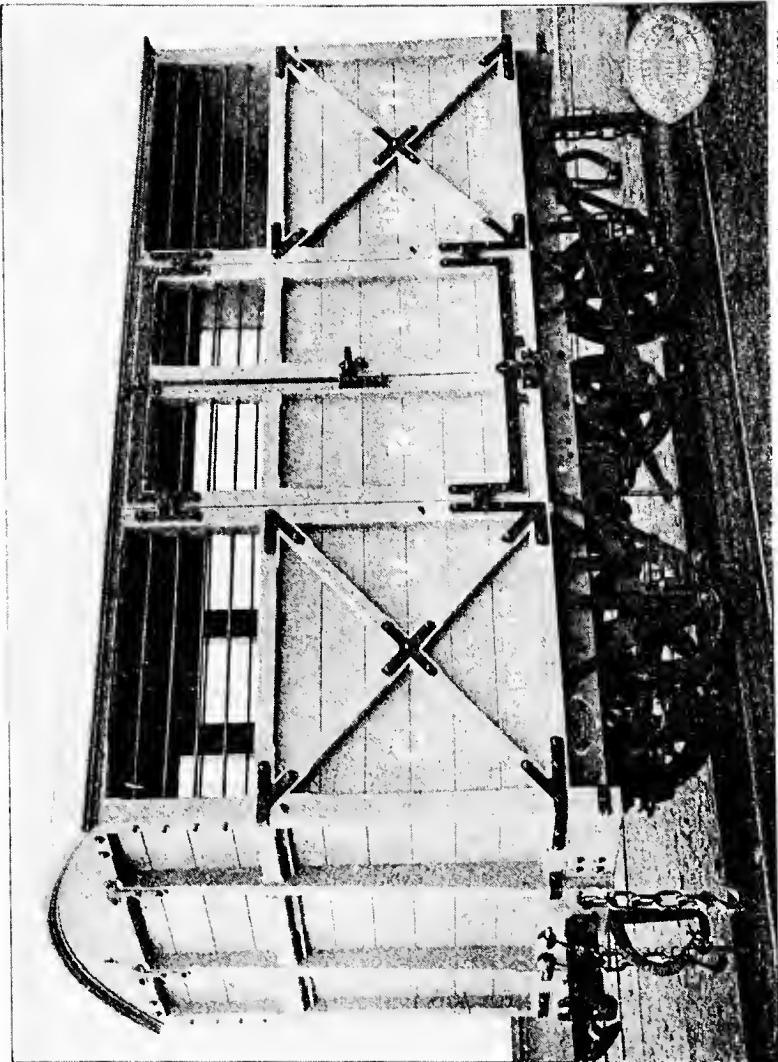


IRISH LIGHT RAILWAYS

THIRTY SPRAGUE & CO LONDON

[Between pp. 100 and 101.]





IRISH LIGHT RAILWAYS.

INKPHOTO SPRAGUE & CO. LONDON





IRN PHOTO SPRAGUE & CO LONDON

IRISH LIGHT RAILWAYS.

[Between pp. 100 and 101.]



The ten-wheel tank engines have four-wheel leading bogies and six wheels coupled. The coupled wheels are 3 ft. 6 ins. diameter, and the fixed wheel-base is 9 ft. The engines carry 650 gallons of water, 2 tons of fuel, and weigh 30 tons in working order. The gross working load is 100 tons up 1 in 40, and the coal consumption 21 lbs. per mile.

The passenger carriages are mostly of the six-wheel type, with a 20-ft. radial wheel-base, divided into five compartments each. There are also other carriages on bogies, 32 ft. long, with seats arranged as in a tramcar. The open trucks have four wheels, with a wheel-base of 8 ft. The tare weights are from 2 tons 10 cwts. to 2 tons 15 cwts., and the load carried is from 5 to 6 tons. The covered trucks weigh 4 tons 13 cwts., and carry 7 tons. The engines and coaches, and most of the trucks, are fitted with the automatic vacuum brake. There are repairing shops, engine-sheds, etc., at certain places.

The railways are worked with staff and ticket, and in some cases with the electric staff.

The light railways constructed under the Tramways Acts (Ireland), 1860 to 1883, have been largely subsidized by Government, and the following lines, amongst others, have raised their capital as under—

			£
Cavan, Leitrim, and Roscommon	...	200,000	guaranteed at 5 per cent. per ann.
Clogher Valley Tramway	...	121,500	" " "
Cork and Muskerry	...	75,000	" " "
Tralee and Dingle	...	120,000	" 4 "
"	...	30,000	ordinary shares, on which no interest has yet been paid.
West Clare	...	163,000	guaranteed at 4 per cent. per ann.
"	...	16,500	ordinary shares, on which no interest has yet been paid.

The total capital on the light railways under these Acts amounts to £1,074,349, and the ordinary capital raised amounts to £111,730. The capital guaranteed amounts to over £4000 per mile, a sum more than should have been spent in the construction and equipment of such railways.

The amount to be contributed from public funds towards the construction of railways authorized under the Light Railways

(Ireland) Act, 1889, the Railways (Ireland) Act, 1890, and the transfer of Railways (Ireland) Act, 1890, is as under—

Name of Railway.	Miles.	Amount. £	Working Railway Company.
Achill Extension .. ..	8 $\frac{1}{4}$	59,000	Midland Great Western.
Ballina and Killala .. ..	8	44,000	"
Baltimore and Skibbereen .. ..	7 $\frac{3}{4}$	56,700	Cork, Bandon, and South Coast.
Bantry Bay Extension .. ..	1 $\frac{1}{4}$	15,000	"
Collooney and Claremoris .. ..	47	150,000	Waterford and Limerick.
Donegal and Killybegs .. ..	18 $\frac{3}{4}$	115,600	Donegal.
Downpatrick, Killough, and Ardglass .. ..	8	30,000	Belfast and County Down.
Galway and Clifden .. ..	48 $\frac{1}{4}$	264,600	Midland Great Western.
Headford and Kenmare .. ..	19 $\frac{3}{4}$	50,000	Great Southern and Western.
Killorglin and Valentia .. ..	26 $\frac{3}{4}$	85,000	"
Stranorlar and Glenties .. ..	24 $\frac{1}{2}$	116,000	Donegal."
Westport and Mallastranny .. ..	18	131,400	Midland Great Western.
	236 $\frac{3}{4}$	1,117,300	

Or an average of £4714 per mile.

It will be seen from Table H that the light railways of Ireland earn very little interest on their capital cost. Some of them are worked at a loss, even with a revenue of 1s. 5d. to 1s. 7d. per train mile, and the working expenses are higher in every case than they should be. The railways are no doubt very advantageous to the districts through which they pass, and tend to improve the social and moral condition of the people; but without Government assistance the lines could not have been made of the substantial build they are at present.

If light or local railways are to be constructed in this country, without financial assistance from either Government, or the rates, they will have to be made on a system entirely different from that of the so-called light railways of Ireland, and at a much less cost per mile. It may be argued whether such a system should not have been applied in Ireland, and, for the same amount of money that has been spent on these lines, have built at least twice the mileage.

There is sufficient traffic on all the lines to pay working expenses, and interest on a capital cost of £2000 per mile; for this amount, a railway of 2 ft. 6 ins. gauge, with 30-lb. rails, and correspondingly

of light construction for earthworks, and equipment, could have been obtained sufficient for all the traffic that is likely to come over these lines for many years.

Several of the railway managers complain of the break of gauge caused by these lines, and say that they should have been constructed on the standard gauge, and so have avoided the transhipping of goods at the junctions. It is not difficult to see what would have been the position of these lines financially had that been done. It is bad enough now, but with a capital cost of at least £1600 per mile more, and an increased cost in the working expenses, the annual deficit would have been very considerable.

As to the evils of transhipment, about which so much is made, the argument loses its point, when the traffic returns for each line are examined separately. The chief earnings of the lines are from passengers, and no considerable inconvenience can occur to them from having to change trains at the junctions. They have to do this often, from one main line to another, and the advantages of having railway communication into an out-of-the-way district is well worth the trouble of changing carriages, rather than having to make the journey by coach or otherwise.

In the case of the goods traffic, the whole of the tonnage passing over the lines selected for illustration is given in the table below. It may be assumed that only a small proportion of this would require transhipping, but even if the whole were transferred from the broad to the narrow, and *vice versa*, the undertaking would not be very serious.

Name of Railway.	Total tonnage.	Average tonnage per day.	Average tonnage per mile per annum.
Ballycastle .. .. .. ..	9,530	32	596
Londonderry, Letterkenny, and Lough Swilly .. .. .. ..	47,989	159	1,548
West Clare .. .. .. ..	10,724	36	397
Cavan and Leitrim .. .. .. ..	17,116	57	356
Clogher Valley .. .. .. ..	16,170	54	437
Cork and Muskerry .. .. .. ..	13,461	45	748
Tralee and Dingle .. .. .. ..	8,823	29	238

The traffic requiring transhipment varies from day to day, but, by taking the highest figures as the daily average, the task is even

then a very light one. The cost of transhipment for general goods varies from  $1\frac{1}{2}d.$  to  $4d.$  per ton, and an outside average figure for this work would be  $3d.$  per ton. If we capitalize the tonnage per mile at this figure, at 4 per cent., in the case of the Londonderry line, we get £500, and of the Tralee and Dingle £75, as the extra amount of capital that may have been spent per mile, to have avoided transhipment. Taking the figures given elsewhere, viz. £1600 per mile, as the saving between an ordinary standard and narrow gauge line, we save a capital of £1100 per mile in the former case, and £1525 per mile in the latter case, after paying all expenses of transhipment, by adopting a narrow-gauge railway.

The total traffic has been taken in these instances, but had the actual traffic transhipped been obtained, the difference would have been still more favourable to the break of gauge.

**The Listowel and Ballybunion** is a single-rail railway 10 miles long, known as the Lartigue system. The track consists of a double-headed rail, supported on angle-iron trestles, about three feet from the ground. On each side of these trestles, about 1 ft. 6 ins. below the bearing rail, runs a guide-rail which keeps the vehicles in a vertical position. The trestles are attached to steel sleepers 3 ft. 3 ins. long and 6 ins. wide, resting on wooden sleepers 6 ft. 0 ins.  $\times$  9 ins.  $\times$  3 ins. The trestles are spaced about 3 feet apart. The weight of the bearing rail is 27 lbs. to the yard, in 33-ft. lengths, and the guide-rails weigh 11 lbs. each per yard in 20-ft. lengths. The crossing from one line to the other is effected by making a length of the road turn on its base, and at public level crossings a somewhat similar arrangement is adopted.

The gradients and curves are as on other lines, and the maximum speed is 24 miles an hour. The cost of construction was £3666 per mile, including rolling stock, and the cost of maintenance in labour only, is £35 per mile per annum.

The line was opened in 1888, with a capital of £11,000 5-per-cent. debenture stock, and £22,000 ordinary stock. Last year the line paid the interest on the debenture stock, and earned  $\frac{1}{2}$  per cent. on the ordinary stock.

The locomotives weigh  $6\frac{1}{2}$  tons, with a tender weighing 3 tons in addition. Owing to the peculiar nature of this system of railway,

PLATE XXII.



INK-PHOTO SPRAGUE & CO LONDON

LISTOWEL AND BALLYBUNION RAILWAY.  
(LARTIGUE SYSTEM.)



the engine has two separate boilers, and the driver and firemen are on opposite sides, being separated by the frame or girder which carries the supporting wheels of the engine, and to which the boilers are affixed. The engine is, however, arranged so that it can be worked from either side as desired. The tender carries 200 gallons of water, 1 ton of coal, and the consumption of coal is from 15 lbs. to 18 lbs. per mile.

The tractive power of the engine is equal to a gross load of 88 tons up 1 in 80. The steepest gradient on the line is 1 in 45. The carriages are 18 ft. long and 9 ft. wide. They are arranged on the bogie principle, and are carried on either side of the centre rail. They are constructed to hold 28 passengers ; the seats are arranged longitudinally, the passengers sitting back to back. The waggons are on the same principle as the carriages, the open ones weigh  $3\frac{1}{10}$  tons, and carry 5 tons, the covered ones weigh  $3\frac{1}{2}$  tons, and carry 4 tons.

The Westinghouse break is fitted on the engines, carriages, and vans. The train service provides for two trains per day each way, during winter, and for four each way during summer. The line is worked by means of the staff and ticket.

The cost of construction and equipment, and the working expenses, do not vary from what a small railway of the ordinary type might be built and worked for.

The passengers carried last year numbered 39,578, and the tonnage of goods 8487 tons. The receipts amounted to £2283 ; or per mile £228 ; or per train mile 2s. 10d. The working expenses were £1663 ; or per mile £166 ; or per train mile 2s. 0d.

The rates charged are for sand 2d., breadstuffs 3d., and timber 4d. per ton per mile. (Plate XXII.)

TABLE G.  
LEADING PARTICULARS, CAPITAL, AND COST OF CONSTRUCTION, ETC., OF SOME RAILWAYS IN IRELAND.

NAME OF RAILWAY.									
BALLYCASTLE.	WEST CLARE.	COVAN AND LETTERMLA.	CLONHEER.	CLONKEEY.	COLEHILL.	CORK AND MACROOM.	LISMORE AND BALLYBUNION.	TRALE AND DINGLE.	WESTERLY, AND DUNDALK.
feet	3 0	3 0	3 0	3 0	3 0	3 0	3 0	3 0	5 3
miles	16	31	27	37	48	18	37	25	5 3
lbs.	45	42 & 50	50	45	—	50	50	—	58
1 in	50	60	—	—	30	45	45	—	—
feet	660	396	—	—	—	363	231	66	—
miles	25	33	25	—	—	25	35	30	—
£	5,723	8,739	6,666	4,171	3,286	4,166	4,054	3,666	8,202
per mile (rolling stock only)	—	—	740	—	—	—	—	—	—
Interest paid, per annum, on—									
Ordinary stock	nil	41 & nil*	nil	—	—	nil	nil	1½	nil
Guaranteed	41	—	4	5	—	4	—	—	5†
Preferential	—	—	—	—	—	—	—	—	—
Loans	—	—	4 & 5	4 & 5	—	—	—	5	4 & 5
Debenture stock	—	—	4 & 5	4 & 5	—	—	—	4	—
Capital raised in—									
Ordinary stock	£ 51,574†	98,634	16,500	163,500	200,200	121,580	75,000	30,000	92,010
Guaranteed	10,000†	—	—	—	—	—	—	120,000	—
Preferential	—	49,625	—	—	—	—	—	—	—
Loans	30,000	10,264	—	—	—	—	—	11,000	44,150
Debenture stock	—	15,400	—	—	—	—	—	—	64,760

\* Letterkenny branch.

† Levied on ratable property in county and city of Waterford for five years during construction, and for thirty-five years after opening.

‡ By barony, at 5 per cent.

TABLE H.  
REVENUE AND WORKING EXPENSES OF SOME RAILWAYS IN IRELAND.

NAME OF RAILWAY.										
	Bally-	Limerick	West	Cavan	Clogher	Cork and	Tralee	Istowel	Cork and	Dundalk,
	castic.	and	Clare.	Leitrim.	Valley.	Muskevery	and	Bally-	Macroom.	Newry,
Receipts per mile, passengers	£	195	211	234	89	898	75	165	301	173
", " goods		97	215	186	92	100	50	82	321	236
", " sundries		"	2	3	—	2	—	16	5	119
Gross earnings		292	628	878	176	501	126	253	627	528
Working expenses		195	277	342	170	169	404	378	202	683
Net earnings		97	261	31	5	4	97	—	51	242
Gross earnings		2	6	8	210	19	2	4	2	3
Working expenses		1	8	1	8	1	5	10	10	7
Net earnings per train mile		0	10	1	7	0	1	—	0	8
Working expenses of gross earnings		67	52	92	97	98	81	—	79	61
Net return on capital		17	28	0·4	—	20·8	—	1·39	2·95	—
Maintenance	£	420	664	107·5	41·3	32·1	86·4	75·6	46·0	77·7
Locomotive power		70·6	78·9	76·9	63·4	67·0	128·1	116·0	61·0	93·3
Repairs & renewals of waggons & coaches		12·3	7·4	22·6	11·8	7·8	28·0	9·3	27·5	18·2
Traffic charges		43·3	82·0	88·8	47·8	34·2	100	35·6	44·1	114·3
General charges		11	20·6	30·5	31·4	11·1	23·4	36·3	16·8	17·4
Other charges, and legal & parliamentary		11	6·2	12·8	14·9	5·1	4·5	36·2	12·8	6·0
Maintenance	per train mile	4·26	4·83	9·81	5·07	3·16	4·84	11·71	4·41	6·40
Locomotive power		7·16	6·83	7·02	6·55	6·20	6·90	17·97	5·85	7·68
Repairs, etc., as above		1·24	0·54	2·05	1·44	0·77	1·23	1·44	2·68	4·82
Traffic charges		4·43	6·16	8·11	4·83	3·37	5·84	5·50	4·22	9·17
General charges		11	0·62	0·91	1·86	0·62	0·44	2·31	1·98	2·60
Other charges, and as above		"	"	"	"	"	"	2·00	19·38	0·57
Passenger carried per annum	N <sup>o</sup> .	105,228	305,173	108,491	84,780	107,987	387,059	32,760	41,504	147,954
Tonnage of Goods and live stock	tons	9,550	47,389	10,724	17,116	16,170	13,461	8,823	7,687	30,596
Passenger carried	No.	6,576	9,844	3,838	2,919	18,725	885	4,611	5,918	4,786
Tonnage of goods, etc.	tons	596	1,538	897	956	4,437	748	1,233	1,449	2,911
Train mileage per annum	..	2,065	8,238	2,628	1,965	2,429	4,216	1,649	2,603	2,099

## BELGIUM.

The light railways of Belgium have been instituted since 1885. These railways are constructed and organized by the Société Nationale des Chemin de Fer Vicinaux ; whilst the capital is found by the State, the Provinces, the Communes, and a small part by individuals. No railway can be made unless sufficient capital has been subscribed previously, to ensure its construction and equipment.

The Government saw that such an important work could not be left entirely to private enterprise, and so allowed the above-named society to take the matter in hand, and granted to it the preferential right of constructing any light railway in that country, provided that the Government was satisfied that it was beneficial to make it.

The railways are generally laid alongside the public roads, and are worked very cheaply. They communicate with all the principal standard-gauge railways, thus giving ready access to them for goods and passengers, tending to develop new districts, affording more numerous outlets for agricultural products, and providing means of communication with districts that would otherwise be hopelessly isolated. The lines are built on the metre gauge, and this has only been departed from, where the railways join those on the Dutch gauge of 3 ft. 6 ins., or on very short isolated branches running out of the standard gauge.

The National Society of Local Railways has its head-office in Brussels, and its object is declared to be the construction and working of local railways in Belgium, and possibly their extension into other countries.\*

The society is permitted to place its available funds in the deposit or current account of the National Savings Bank and Provident Fund, or in the Banque Nationale, while it may also purchase debenture bonds issued or guaranteed by the State, the Provinces, or the Communes ; but all other financial operations are expressly forbidden.

The society, which can only be wound up by virtue of a law that will regulate the conditions, may abandon a line, if during three

\* The *Engineer*, March 29, April 5 and 19, 1895.

consecutive years the gross receipts remain insufficient to cover the expenses of working, or if during five consecutive years the profit be less than 50 per cent. of the interest on the formation capital.

The share capital which equals the cost of constructing the lines, and, if necessary, equipping them with rolling stock, will be divided into so many series of shares (each share bearing the value of £40) as the lines conceded; and to each series of shares are attached the profit earned by the line which it represents, but only within the limits mentioned below, whilst at least two-thirds of the shares of each series must be subscribed by the State, the Provinces, and the Communes.

It was not considered—and the event has confirmed this as a rule—that local railways would be a bad investment for the Communes, considering the economical conditions under which the lines are made, and the very low rate of interest under which the money is obtained.

The liability of shareholders is limited to the amount of their holdings, and the State and Provinces may pay their shares of the capital in annuities extending over ninety years, as also may the communal authorities on giving proof of sufficient resources.

All shares in arrear bear interest at the rate of 6 per cent. per annum; and after repeated notice at intervals of two months, the council of the society may annul the shares in arrear, in which case all amounts paid in remain acquired to the society.

After the expiration of the nineteenth year of working a line conceded, the State, the Provincial, and the Communal authorities interested, will have the right to buy at par, *pro rata* of their subscriptions, the shares originally subscribed by individuals; and the society is empowered to issue debenture bonds representing the annuities due to it.

The society and its lines are relieved, as far as possible, from the payment of dues, rates, and taxes.

The society is managed by a council consisting of a president, four administrators, and a director-general. The president is nominated by the King for six years; and the nomination may be renewed indefinitely for the same period. There is a supervising committee consisting of six members; and the Government

reserves the right of examining all the books and documents, for checking the operations of the society.

A separate account is kept for each line, showing the expenses of construction and maintenance, and eventually those of working; and the share to be borne by each line in the general expenses of the society is determined by the amount of receipts which it contributes.

When a line is worked at a loss, the deficiency is made good by the society, which reimburses itself from the first profit made by that line; and if the line be abandoned, the loss will be debited to the reserve fund.

The profits of each line are distributed in the form of a first dividend amongst the shareholders, up to  $4\frac{1}{2}$  per cent. of the capital; and the surplus (after deduction of certain percentages, due for their services, to the administrators and director-general, is distributed) —one quarter to form an individual reserve fund as provision for extensions and improvements; three-eighths to the shareholders by way of second dividend; and three-eighths to the society for forming a general reserve fund to cover possible losses, and permit extensions and improvements of the whole system.

The funds of the individual reserve funds may now, with Government sanction, be applied to the payment of dividends.

In the event of a local line being bought up by the State, the price paid will be applied to reimburse, totally or partially, the payments made by the shareholders; and the surplus, if any, will be applied, half for distribution amongst the shareholders, and half as a contribution to the general reserve fund.

In the event of the society abandoning an unproductive line, there is provision for its being handed over, under certain conditions, to a group of shareholders who may be directly interested in keeping it running; but in no case can the society recover the sums advanced for working.

Every application for a concession must be accompanied by—

1. A report as to the object, advantages expected, existing communications, and the influence likely to be exerted upon them by the new line.

2. A detailed estimate of cost.

3. The proposed rates, and an estimate of the probable receipts, with consideration in support.
4. A complete specification of the project.
5. Part of a Government map, to the scale of 1 : 20,000, showing the proposed course of the line.
6. A general plan of the localities, to the scale of 1 : 2500, showing the proposed line and sidings.
7. A special plan, to the scale of 1 : 200, for each part of the proposed railway passing through portions of the commune where there are houses, and as to which detailed instructions are given.
8. A longitudinal section, with a sufficient number of transverse sections; and
9. Detailed drawings of the principal works and type of permanent way.

The application for a concession is to be made by the society to the Department of Agriculture, Industry, and Public Works, which may require that the documents and drawings be multiplied to such an extent as may be considered necessary, the whole at the expense of the Society. The above Government department will then submit the project to a preliminary examination, completing and modifying it if necessary, and will decide whether it shall form the subject of an inquiry, the expense, both of the examination and the inquiry, being borne by the society.

All the documents, etc., relating to the project, remain open for a fortnight to public inspection at the Town Hall of each commune interested, after publication of the fact. Any observations, duly signed, are included in a report; and this, together with the opinion of the Common Council, must be forwarded within a week to the provincial authority, which must, within a fortnight, pass them on, with its opinion, to the Department of Public Works.

This body will then, through the society, make any modifications that the inquiry may have shown advisable; and if they involve changes in the trace of the line, the Department of Public Works will determine if there be necessity for a fresh inquiry, in which case the formalities are the same as for the first. On their being terminated, the Department is to definitely settle the drawings and

specifications, but no concession becomes definite until signed by the King.

The total receipts for 1893, for all the lines, amounted to—

	£
Receipts ... ... ... ... ... ...	187,374
Expenditure ... ... ... ... ...	133,615
Balance ... ... ...	<u>£53,759</u>

and deducting interest at 4 per cent. on the excess of expenses over receipts, in the case of four lines which did not pay, we have a profit of £52,834 on the year's working, giving a ratio of expenses to receipts of 71 per cent.

A comparison of the total receipts in 1892 and 1893, for those lines only which had been in operation for two complete years, shows an increase for the latter year of £11,061.

The following table gives the proportions of receipts from goods and passenger traffic on lines which carried both—

	Passengers and luggage, per cent.	Goods, etc., per cent.
1886 ... ... ... 93.35	...	6.65
1887 ... ... ... 87.04	...	12.96
1888 ... ... ... 79.25	...	20.75
1889 ... ... ... 71.62	...	28.38
1890 ... ... ... 75.36	...	24.64
1891 ... ... ... 73.26	...	26.74
1892 ... ... ... 73.56	...	26.44
1893 ... ... ... 72.16	...	27.84

Of the fifty-six lines in operation at the end of 1893, four of them showed a balance on the wrong side of £484. The whole amount of loss, however, from the beginning of the society's operations in 1887, to the end of 1893, only amounts to £3079; and, to meet this, there is the general reserve fund of £8795, while all the other lines have in addition, to back them up, the special reserve fund of each line, amounting together to £5852.

Independently of the figures given in the table of the actual expenses for working each line, the general administrative expenses for the whole of the lines were maintained at £11 per mile, this figure having been £12.8 in 1892.

The general expenses are kept very low, representing only 3·68 per cent. of the total expenses for making and stocking the lines.

The total amount of capital subscribed at the end of 1893 was—

	£
By the Government	493,440
By nine Provinces	501,120
By the Communes	730,920
By individuals	81,000
 Total capital	<u>£1,806,480</u>

The following table gives the proportional lengths for the three gauges adopted of all the lines made up to the end of 1893, laid along roads, on roads widened, and on land bought for the purpose, the term, "main line," being here employed for the working length, to the exclusion of sidings, etc.—

	MAIN LINE AND GAUGE.			
	3 ft. 3½ ins.	3 ft. 6 ins.	4 ft. 8½ ins.	Total.
	miles	miles	miles	miles
On roads not widened	404·64	117·81	5·67	528·12
On roads widened	33·12	5·39	—	38·51
On purchased land	149·93	6·12	4·33	160·38
	587·69	129·32	10·00	727·01
Sidings, etc.	86·70	17·76	2·65	110·11
Main and accessory lines together	674·39	147·08	12·65	837·12

The type of gauge chosen by the society is that of one metre (3 ft. 3½ ins.), which has the double advantage of permitting economy in construction, and of meeting all probable increase of traffic that may be expected on a line under standard gauge. The Dutch local gauge of 3 ft. 6 ins. has been adopted only in the case of lines put out towards Holland, with a view to joining and working in connection, with pre-existing or future lines, the permanent way and rolling stock not differing greatly between the metre and the Dutch local gauge. The standard gauge of 4 ft. 8½ ins. was admitted, only by way of exception, in the case of a few lines of slight length and likely to carry heavy traffic.

Gradients of 1 in 40 are rarely exceeded on the local lines; but three of them have much sharper gradients, as will be seen by the following particulars. One from Brussels to Petite Espinette of metre gauge, 6 miles long, is worked electrically, with overhead wire and trolley, on the Thomson-Houston system. Out of a total length of 8 miles, a little more than  $\frac{3}{4}$  of a mile includes the following gradients. The sharpest is 1 in  $21\frac{1}{4}$  for a length of 90 yards; the next 1 in  $22\frac{3}{4}$  for 148 yards; also two of 1 in  $23\frac{1}{4}$ ; one of 1 in 22; three of 1 in 25; two of 1 in  $26\frac{1}{2}$ ; one of 1 in 27; one of 1 in  $34\frac{1}{2}$ ; one of 1 in 37; and two of 1 in 40.

There are far sharper gradients, however, on one of the Charleroi lines, 5 miles long, and worked by locomotives, between Lodelinsart and Chatelet, viz. gradients of 1 in  $14\frac{1}{4}$  for a length of 33 yards; of 1 in 16 for 88 yards; of 1 in  $17\frac{1}{4}$  for 495 yards, and of 1 in 18 for 66 yards. There are also gradients on this line ranging from 1 in  $20\frac{1}{2}$  to 1 in  $33\frac{1}{2}$ .

Another line, interesting as regards gradients, is that between Paliseul and Bouillon, 9 miles long, and worked by locomotives. It has several gradients of 1 in  $28\frac{1}{2}$ , and two of  $27\frac{3}{4}$ , one of the latter being more than 1000 yards long. More than half the line consists of gradients of 1 in 40 and over, including one 1247 yards long of 1 in  $33\frac{1}{2}$ .

Whereas, in 1892, the local lines had 57 points of connection with railways of standard gauge, at the end of 1893 the number of such points increased to 62, and break of gauge occurs at each one.

In the course of 1893, 19 private sidings were made in connection with the local lines, bringing up the total number, at the end of that year, to 93, of which 31 may be regarded as specially agricultural, and 61 industrial, serving quarries, collieries, coal-depôts, gas-works, brick-works, lime-kilns, foundries, and engine-works.

Wherever possible, the system of public tender is adopted for contracts connected with permanent way, *including* earthwork, bridges, and other works, platelaying and building, as well as rolling stock.

The expenditure was as follows to the end of 1893:—

							£
Permanent way materials, and works	...	...	...	...	...	...	718,558
Rolling stock	...	...	...	...	...	...	457,503
Buildings	...	...	...	...	...	...	612,237
							<u>£1,788,298</u>

It is calculated that £128 per mile should suffice to repay to the society preliminary expenses, and the cost of watching the construction. This amount is included in all estimates.

The society possessed at the end of 1893—

245 locomotives,  
663 passenger carriages,  
1574 goods waggons and luggage vans.

The mean expense for rolling stock, including engines, amounts to £650 per mile, being (not including sidings) per mile—

0.33 locomotives,  
0.9 coaches,  
2.13 goods waggons.

The locomotives weigh about 18 tons each ; there are also a few of less weight, and some up to nearly 30 tons. Of the waggons, more than 70 per cent. carry 10 tons, the remainder being for freight of 5 tons, and a few also for freight of 20 tons.

When the railways are completed and equipped, the society lets them out to subsidiary companies to maintain the permanent way, renew and repair the rolling stock, and work the lines generally. These companies receive a fixed percentage of the gross receipts, with a guaranteed minimum in some cases of £128 per mile per annum. Details of the agreements for working will be found in Appendix VII.

No accident occurred in 1893 from collision or derailment, but five passengers were killed and three injured, through their trying to pass from one carriage to another, or mounting or descending while the train was moving. All the other accidents, forming the greater number, were due to drunkenness, suicide, or imprudence.

In addition to the local lines worked by the society, there are six others conceded to companies, forming a length of 36 miles, so that, at the end of 1893, Belgium possessed a secondary railway system of 763 miles as against 2827 miles of standard gauge, or about 30 per cent.

The main results of the Belgian light lines are as under—

Miles open	...	...	...	...	...	730	
Cost per mile—Construction	...	...	...	...	...	...	£1818
"    Rolling stock	...	...	...	...	...	...	£650
"    Land	...	...	...	...	...	...	£220
							£2688
Gross earning per mile	...	...	...	...	...	...	per annum. £286
Working expenses	,,	...	...	...	...	...	£204

In addition, the society takes £11 per mile per annum for supervision and payment of directors, etc.—

	s.	d.
Gross earnings per train mile	...	1 2½
Working expenses	,,	0 10
Working expenses per cent. of gross earnings	...	71·31
Net return on capital	...	3·05

Amongst other advantages of the principle thus adopted in Belgium of having one central administrative body in the nature of a public trust, for carrying out light railway undertakings, with separate capital accounts for each line, the following may be cited :—\*

1. Great saving in personnel and cost of management.
2. The society holds, for negotiations with the main-line companies and others, a much stronger position than could ever be the case were the undertakings left to small isolated companies.
3. Wild-cat speculations are discouraged.
4. Local authorities become the proprietors, with private subscribers, of the lines in which they are concerned, and whilst the operations of the society are carried out on strictly commercial lines, the subscribers have the strong support of a Government guarantee, for the protection of the interests of individual undertakings.
5. The fact of the working of the society being centralized under the eyes of the Government greatly facilitates control by authorities ; and the society remains directly responsible to the State for the due carrying out of its obligations, and of the regulations which may be made in the public interest.

In making technical and other regulations for the construction and working of light railways, the principle adopted by the Belgian Government appears to be, to keep them as simple as possible, and to tie the hands of those who are intrusted with their carrying out, as little as is consistent with a due regard for public safety and convenience.

At the end of 1893, a further network of 900 miles of these railways were either in course of construction or seriously taken in hand.

† **Taviers to Embresin**, 2 ft. 4 ins. gauge ; 30-lb. rails.—This

\* Circular issued by the Mansion House Association on Railway and Canal Traffic, compiled by F. C. Fairholme, A.M. Inst. C.E.

† *Min. Proc. Inst. C.E.*

line, on a 2 ft. 4 ins. gauge, was constructed to open up the rich and fertile district known as Hesbaye, which by reason of its forming a quadrilateral between existing main lines was previously cut off from railway communication. The railway is about 6 miles long, and an extension is proposed.

The weight of the rail is 30 lbs., the maximum gradient 1 in 66, and the radius of the sharpest curve 328 ft. The speed of the trains is limited to 9 miles an hour. The *cost of the line, without rolling stock*, was about £2000 per mile. There is an iron bridge 420 ft. long, a viaduct, and a bridge on iron piers, on the line. The earthwork amounted to 10,000 cubic yards per mile.

The *rolling stock* consists of—

							£
2	locomotives, costing	...	...	...	...	...	1440
2	brake-vans	...	...	...	...	...	160
2	passenger carriages	...	...	...	...	...	360
3	jardinieres	...	...	...	...	...	240
25	5-ton waggons	...	...	...	...	...	1400
7	5-ton platform waggons	...	...	...	...	...	336
							<hr/>
	Total	...	...	...	...	...	£38936
							<hr/>
	or per mile	...	...	...	...	...	£656

The line carried, in 1881—

Goods	...	...	...	17,354 tons = 2892 tons per mile.
Parcels	...	...	...	230 No.
Passengers	...	...	...	40,294 No. = 6715 No. ,,

Yielding a revenue of £1550 per annum, or £258 per mile per annum.

The cost of fuel, oil, grease, etc., averaged £18 per month, or £216 per annum. Twelve persons are employed, viz.—

- 1 Inspector.
- 2 Engine drivers.
- 1 Stoker.
- 1 Clerk.
- 1 Receiver.
- 6 Workmen.

The break of gauge at Taviers involves a cost of about 2d. per ton for transhipment, which service is performed by a special contractor, unless the parties prefer to do it themselves by their own workmen.

TABLE I.\*  
PARTICULARS OF COST, REVENUE, AND EXPENDITURE ON LIGHT RAILWAYS IN BELGIUM.

	Date of opening.	Gauge.	Miles worked.	Cost per mile.	Receipts.		Expenditure.	Relation of expenses to receipts.
					Total.	Per mile.		
1. Ostend—Furnes	1885	metre	20·8	49·372	6,827	328	5,115	24·9
2. Ostend—Blankenberghe	1886	"	13·2	45,928	5,976	452	4,033	305
3. Furnes—Ypres	1889	"	22·9	50,621	5,009	219	3,484	152
4. Antwerp—Hoogstraeten—Turnhout	1885	3 ft. 6 ins.	38·4	85,285	2508	13,532	8,897	231
5. Antwerp—Santhoven—Lierre	1889	"	17·3	38,931	2433	4,169	2,411	2550
6. Poix—Saint Hubert	1886	metre	4·0	12,688	3172	1,303	908	227
7. Mehreux—Laroche	1886	"	11·3	31,536	2628	2,841	261	1629
8. Andenne—Eghée	1886	"	13·8	30,716	2457	3,780	274	2818
9. Samson—Andenne—Gives	1887	"	8·7	19,564	2302	1,596	183	1011
10. Ghent—Somergem	1886	"	8·9	25,009	2778	3,088	347	2504
11. Thielle—Aelbre	1886	"	11·2	25,267	2297	1,520	1,520	1,592
12. Hooglede—Thielt	1889	"	20·7	51,967	2535	3,474	168	3058
13. Charleroi—Mont-sur-Marchienne	1887	"	2·0	8,458	4229	1,190	595	837
14. Charleroi—Lodelinsart	1882	"	2·2	11,838	5261	1,916	871	1370
15. Lodelinsart—Chatelet	1891	"	5·3	16,853	3371	1,851	336	1,455
16. Charleroi—Montigny-le-Tilleul	1887	"	4·8	19,961	4202	4,407	918	3244
17. Malines—Ilegem—Westerloo	1887—90	3 ft. 6 ins.	24·5	55,364	2116	5,739	234	4,039
18. Antwerp—Merxen	1887	"	3·1	—	—	4,885	1,576	3699
19. Antwerp—Westwegoel—Schoten	1887—90	"	16·9	45,955	2785	4,703	278	2922
20. Antwerp—Santvliet—Lillo	1887—90	metre	24·0	64,946	2706	6,282	262	5095
21. Brussels—Eysenringen	1887—89	"	8·5	23,741	2793	3,568	419	2182
22. Wavre—Iodogne	1892	"	17·4	62,598	3477	5,376	309	3357
23. Louvain—Iodogne	1892	"	18·9	48,890	2716	4,339	229	3167
24. Sprimont—Poulseur	1887	4 ft. 8½ ins.	5·0	24,642	4128	1,813	362	1,038
25. Baulieu de Mons	1887—89	metre	16·7	39,027	2604	5,072	304	3340
26. Bourg—Leopold—Maeseyck	1888—90	"	25·5	47,787	1911	3,704	145	3567
27. Brussels—Enghien	1888	"	19·8	48,954	2576	5,319	269	3698

28. Saint Ghislain—Hautrage ..	..	1888	..	1888	..	12.0	29,920	2410	154	66.8
29. Huy—Waremmé ..	..	1892	..	1892	..	15.9	59,215	3701	2,775	1853
30. Waremmé—Oreye ..	..	1892	..	1892	..	6.3	14,410	2969	6,092	231
31. Saint Trond—Oreye ..	..	1892	..	1892	..	11.1	31,442	3144	1,205	1853
32. Ghent—Safdelare ..	..	1888	..	1888	metre	10.3	23,208	2210	2,764	1853
33. Ghent—Hamme ..	..	1891	..	1891	..	23.5	55,317	2374	3,607	1853
34. Deynze—Andenarde ..	..	1888	..	1888	..	11.7	26,894	2241	1,646	2,775
35. Bourcy—Houffalise ..	..	1889	..	1889	..	7.5	22,689	3241	821	1853
36. Brussels—Haecht (suburban) ..	..	1889	..	1889	..	4.0	47,495	2794	4,953	2,775
37. " " (local) ..	..	1890	..	1890	..	12.9	{	{	4,964	2,775
38. Brussels—Sterrebeek (suburban) ..	..	1891	..	1891	..	6.6	36,262	5180	2,520	2,775
39. " " (local) ..	..	1892	..	1892	..	10.7	41,448	3854	1,395	2,775
40. Brussels—Humbeek ..	..	1889	..	1890	..	15.5	43,833	2828	4,291	2,775
41. Clavier—Van Saint Lambert ..	..	1890	..	1890	..	6.7	26,325	4050	4,405	2,775
42. Quiervrain—Roisin ..	..	1890	..	1890	..	18.8	42,906	2383	3,665	2,775
43. Bruges—Westcapelle—Heyst ..	..	1890	..	1890	..	9.5	32,362	3385	1,725	2,775
44. Paliseul—Bouillon ..	..	1890	..	1891	..	10.0	21,971	2265	1,789	2,775
45. Eecloo—Frontière ..	..	1891	..	1891	4 ft. 8½ ins.	2.7	22,513	8432	796	2,775
46. Dolhain—Goé ..	..	1891	..	1891	metre	8.9	42,364	3959	5,216	2,775
47. La Louvière Lines (centre) ..	..	1891	..	1892	..	12.2	32,006	18.8	1,921	2,775
48. Namur—Saint Gérard ..	..	1892	..	1892	..	6.0	42,711	5476	1,725	2,775
49. Brussels—Petite Espinette (electric) ..	..	1892	..	1892	..	13.7	38,002	2774	1,216	2,775
50. Arlon—Ettrœ ..	..	1892	..	1892	..	18.1	47,841	2658	2,765	2,775
51. Courtai—Wervicq—Menin ..	..	1893	..	1893	3 ft. 6 ins.	9.9	15,301	1974	—	2,775
52. Turnhout—Arendonck ..	..	1893	..	1893	metre	16.6	39,485	2350	489	2,775
53. Louvain—Diest ..	..	1893	..	1893	..	12.0	21,008	1064	6,296	2,775
54. Glous—Cannes ..	..	1893	..	1893	..	7.9	8,781	1064	52	2,775
55. Grimberghen—Londergeel ..	..	1893	..	1893	..	9.7	19,361	1974	492	2,775
56. Saint Nicholas—Kieldrecht ..	..	1893	..	1893	..	8.6	29,401	3380	379	2,775
57. Andenne—Sorvée ..	..	1893	..	1893	..	8.9	8.9	—	—	2,775
58. Namur—Ouvz ..	..	1893	..	1894	4 ft. 8½ ins.	2.2	12,903	5490	2,423	2,775
59. Sicheim—Montaing ..	..	1894	..	1894	metre	8.5	23,943	2747	—	2,775
60. Grupont—Wellin ..	..	1894	..	1894	4 ft. 8½ ins.	4.0	10,505	2828	—	2,775
61. Groenendaal—Overysse ..	..	1894	..	1894	metre	8.1	13,830	1795	—	2,775
62. Clavier—Comblain-au-Pont ..	..	1895	..	1895	..	4.3	41,719	1097	—	2,775
63. Montigny-le-Tilleul—Thurilius ..	..									—

\* Compiled from the *Engineer*, April, 1895.

TABLE J.  
PARTICULARS OF CAPITAL, TRAIN SERVICE, AND WORKING AGREEMENTS ON LIGHT RAILWAYS IN BELGIUM.  
The figures at head of column refer to the No. of Railway in Table I.

	1 Ostend—Furnes.	3 Furnes—Ypres.	43 Bruges—Heyst.	11 Thielt—Aelbre.	12 Hooglede—Thielt.
Capital subscribed by State	per cent. 25·0	per cent. 25	per cent. 25	per cent. 25	per cent. 25
Provinces ..	25·0	25	25	25	25
Communes ..	40·7	48	50	50	50
Individuals ..	9·3	2	—	—	—
The line is worked at per mile per annum by subsidiary company.	70 per cent., up to £288 per mile; 69 per cent. up to £320 per mile; 68 per cent., up to £352 per mile; 65 per cent., beyond this.	All receipts up to £128 per mile; 44·5 per cent. up to £320 per mile, with a minimum of £128 per mile. Above £320 0·1 per cent. less for every additional £6·4 per mile per annum.	65 per cent., up to £256 per mile, less 1 per cent. for every additional £6·4 per mile. Above £320 £16, with a minimum of 61 per cent.	60 per cent., up to £320 per mile, with various provisions for higher figures.	Whole receipts up to £128, and 25 per cent. of all beyond.
	51 Courtrai—Menin.	34 Deyze—Andenrade.	45 Eekloo—Frontière.	56 Saint Nicolas—Kieldrecht.	10 Somergau.
Capital subscribed by State	per cent. 25	per cent. 25	per cent. 25	per cent. 25	per cent. 25
Provinces ..	25	25	25	25	25
Communes ..	50	45	50	50	50
Individuals ..	—	5	—	—	—
The line is worked at per mile per annum by subsidiary company.	All receipts up to £128 per mile; 60 per cent. to £288 (with minimum of £128) per mile; less 0·1 per cent. for every £6·4 above that figure.	All receipts up to £28 per mile; to £128 per mile, and 25 per cent. of all beyond that figure.	All receipts up to £128 per mile, and 25 per cent. of all beyond that figure.	All receipts up to £109 per mile, and 30 per cent. of all beyond that figure.	63 per cent. up to £352 per mile; less 0·1 per cent. for every £6·4 above that figure. (With minimum of £128).
					32 and 33

The National Society charges in addition a sum of £11 per mile, to pay for its own administration and payment of directors, etc.

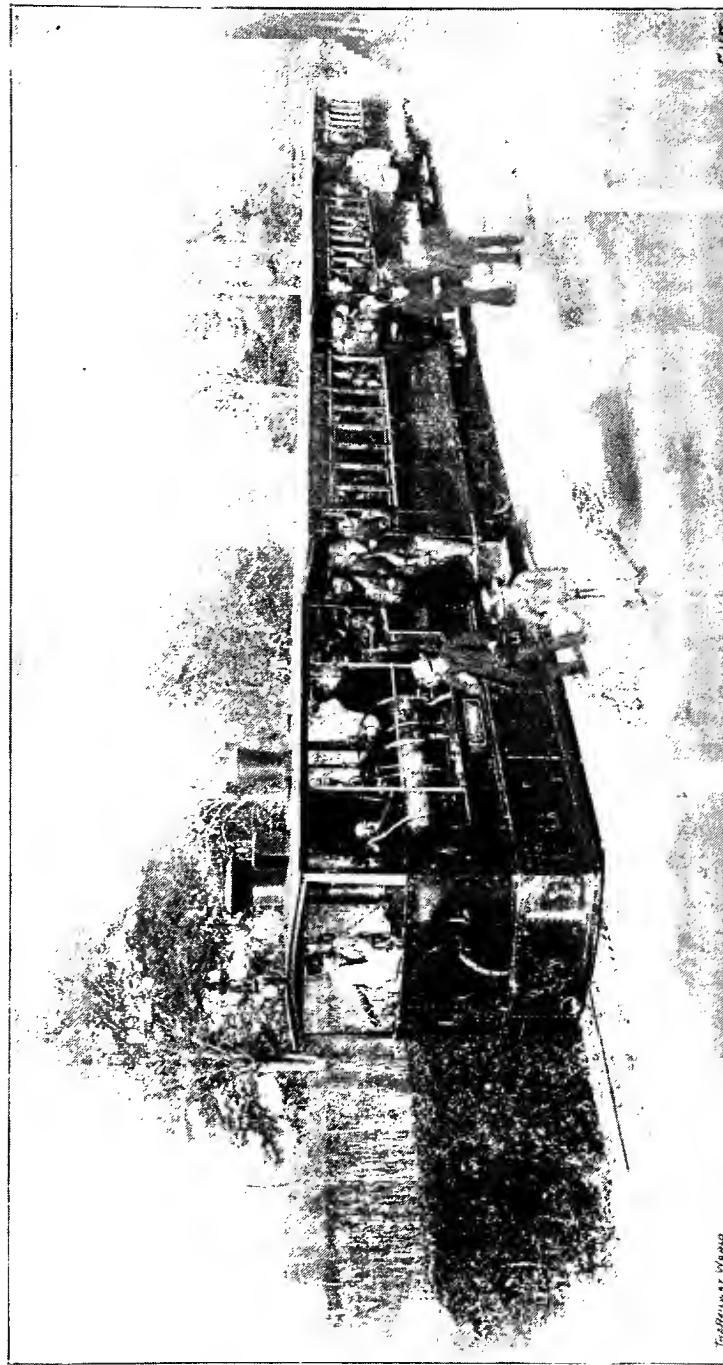


FIG. 26.—Train on Light Railway in the Canton of Geneva.

[From the *Railway World*, March, 1895.]

## NARROW-GAUGE RAILWAYS IN THE CANTON OF GENEVA.\*

*Gauge 3 ft. 3½ ins.; rails 40 lbs. per yard.*

Amongst the countries of the world that are well supplied with railways in comparison with the total area, Switzerland must be allowed to take a very prominent place, and certainly it holds the chief position for variety of systems employed. Not only does it possess a great length of ordinary standard-gauge line, but of mountain railways also, as well as tramways and light railways of varied types and gauges, employing steam or electricity as the motive power.

The Canton of Geneva alone has a most elaborate system of narrow-gauge lines of tramways or light railways, partaking principally of the nature of the former in construction, yet by no means wholly confined to the roads and highways. The Geneva lines may be separated into ordinary railways, narrow-gauge lines and tramways. The respective lengths of these being as follows:—

Lines of normal type	...	...	...	...	19·4 miles
Narrow-gauge lines	...	...	...	...	43·3 "
Tramways	...	...	...	...	9·7 "

Eight of these narrow-gauge lines form a network carried on by a company entitled, "La Société Genevoise de Chemins de Fer à Voie Étroite." The ninth is owned and operated independently. The length of each varies from 2 to 11 miles.

The permanent way of these narrow-gauge lines is carried, wherever possible, along the roads maintained by the Canton. The width of these roads varies from 25 to 40 feet. The gradients, as a rule, do not exceed 1 in 17, but none of these have any great length. At many points, in order to ease the gradients, or avoid troublesome corners, the lines are carried off the road altogether.

The line is placed on one side of the road, but without any foundation work or fence, just as with an ordinary street tramway, and no inconvenience to horses or foot passengers has in any way resulted. Even on market days the trains pass through crowds of buyers and sellers, without the least accident or trouble, the people

\* *Railway World*, March, 1895.

drawing aside at the sound of the driver's horn, and reforming again behind the train; and strangers are sometimes surprised to meet in the crowded streets of Geneva—very narrow in some places—tramway trains of this type, each composed of three or four vehicles drawn by a locomotive.

There are in all seventy fixed stopping-places or stations on this narrow-gauge system, indicated, however, merely by a post bearing the name of the place. Optional halting-places are marked similarly by a round plate sign. At crossings or points where danger might conceivably arise, signboards are put up, with the notice, "Look out for the train," painted upon them in large letters.

The rolling stock includes 22 locomotives, all of the same type, six wheels coupled. These engines run either way indifferently, and may be operated from either end; each is covered over with a light roof, and the sides are panelled so as to hide and protect the working parts. The chief dimensions are as follows:—

Coupled wheels	...	...	...	...	...	6 No.
Load on axle	...	...	...	...	...	5·4 tons
Full weight of engine working	...	...	...	...	...	16½ tons
Heating surface	...	...	...	...	...	259 sq. ft.
Grate area	...	...	...	...	...	5 sq. ft.
Diameter of wheels	...	...	...	...	...	2 ft. 5½ ins.
"      cylinder	...	...	...	...	...	9½ ins.
Length of stroke	...	...	...	...	...	1 ft. 2 ins.
Capacity of tank	...	...	...	...	...	320 gallons
Capacity of bunkers	...	...	...	...	...	800 lbs.
Rigid wheel-base	...	...	...	...	...	6 ft.
Radius of sharpest curves	...	...	...	...	...	150 ft.
Maximum speed per hour	...	...	...	...	...	16 miles

The fuel employed is always coke, when firing in the city, and briquettes when outside. Exhaust steam is not condensed, but escapes noiselessly, and no trouble has been experienced at all on this ground.

The passenger stock comprises a total of 57 carriages, of which 7 are built with a baggage compartment. They are made with end platforms; cross seats, with an aisle running lengthways of the car, leaving two seats on one side, and one on the other. The ordinary cars have sitting accommodation for 24 passengers inside, whilst the platforms carry 12, or a total of 36. They weigh about 4 tons each, or 220 lbs. per passenger. The seats are of perforated

wood, and each car is heated by pipes through which the exhaust steam passes.

Eight goods waggons are used on the line, each weighing 3 tons, carrying 5 tons, and being about 13 ft. 6 ins. long. Three smaller waggons, weighing about  $1\frac{1}{2}$  tons each, and carrying  $2\frac{1}{2}$  tons, find considerable employment in transporting milk.

The full fares are  $1\frac{1}{4}d.$  to  $1\frac{1}{2}d.$  per mile, but rebates are given on certain conditions.

The train service is from 13 to 15 trains each way per day. The running speed averages, including stoppages, from 6 to 9 miles an hour.

						per mile. £
The cost of construction equals	...	...	...	...	...	4992
,,    rolling stock	...	...	...	...	...	768
						<hr/>
Total cost	...	...	...	...	...	£5760
						<hr/>
The revenue averages	...	...	...	...	...	435
The expenditure	...	...	...	...	...	340
						<hr/>
Net revenue	...	...	...	...	...	£95
						<hr/>

or a return of nearly 2 per cent. on the capital. The number of passengers carried is about 1,489,706 per annum, or 4081 per day.

The train miles run in the year were 281,810; an average of about 17 passengers was carried per train accommodating 79, or a proportion of 21 per cent.

The expenditure per train mile is 1s.  $1\frac{3}{4}d.$ , being  $77\frac{1}{2}$  per cent. of the gross receipts, and is made up as under:—

					d.	per cent.
1. Administration	...	...	...	...	0·84	or 6·11
2. Maintenance and repairs of permanent way	...	...	...	...	1·40	„ 10·20
3. Traffic expenses	...	...	...	...	2·13	„ 15·55
4. Locomotive expenses	...	...	...	...	8·03	„ 58·53
5. Various expenses	...	...	...	...	1·32	„ 9·61
					<hr/>	<hr/>
					1 1·72	„ 100·00
					<hr/>	<hr/>

Taking the fourth item in detail, the cost of—

					d.
Management, wages of drivers, stokers, cleaners, etc.	...	...	...	...	3·2
Fuel, oil, water, sand, etc.	...	...	...	...	3·52
Repairs and renewals	...	...	...	...	1·15
Miscellaneous	...	...	...	...	0·16
					<hr/>
Per train mile	...	...	...	...	8·03
					<hr/>

The wages actually due to locomotive expenses average  $2\frac{1}{2}d.$  per train mile ; and the cost of fuel  $3d.$  per train mile. The first item is rather heavy because of Government restrictions upon the hours worked by the employees ; the second is explained by the costliness of fuel— $25s.$  per ton. The consumption of fuel is not more than  $21$  lbs. per train mile. The cost of traction is therefore about  $3\frac{1}{2}d.$  per car mile, which compares favourably with other systems of working.

Some extensions following the highway entirely, have recently been made for £2048 per mile.

## ITALY.

*Gauges, 4 ft.  $8\frac{1}{2}$  ins. to 2 ft.  $5\frac{1}{2}$  ins. ; rails, 42 lbs. and 36 lbs. per yard.*

The light railways \* of Italy were commenced fifteen years ago, and there are now upwards of 1875 miles of these lines in different parts of the peninsula. They form a perfect network of light lines in the valley of the Po, as well as round other important centres, especially in Northern Italy.

They are laid alongside the main roads without any fencing, and the trains run at a limited speed, and are made up of a limited length and weight. The details of construction are not supervised by Government, but a controlling power is exercised over the rolling stock and working arrangements.

The several railways were originally owned and worked by independent companies, but recently an Italian Tramway Association has been formed, and a common basis of working has been established.

The majority of the lines are of the 4 ft.  $8\frac{1}{2}$  ins. gauge, but there are instances of 3 ft.  $7\frac{1}{4}$  ins., 2 ft.  $11\frac{1}{2}$  ins., and 2 ft.  $5\frac{1}{2}$  ins. gauges. These isolated lines form an important part in the economical development of the resources of the country, and the adoption of the narrow gauge has enabled very satisfactory financial results to be obtained in those districts where the limited amount of traffic would not warrant the construction of an ordinary railway.

The width of the ordinary roads is about 26 ft. 3 ins. Twenty-six feet is considered the normal minimum, but in some instances 20 feet

\* *Min. Proc. Inst. C.E., vol. cix.*

have been allowed. In roadways of extra width, of 32 ft. 10 ins. or more, the line is practically separated from the roadway by a series of spur stones. Whilst crossing bridges, the minimum distance between the rail and the parapet is 2 ft. 7½ ins. on one side, and 16 ft. 5 ins. on the other. In some cases, on narrower bridges, iron parapets have been substituted for masonry ones, and the footpath has been carried outside on cantilevers.

In traversing streets, the line is generally laid in the centre of the roadway, but in narrower places it is necessary to have the maximum free width on one side, and consequently the normal minimum width between the rail and the wall of a house has been fixed at 3 ft. 11 ins.

*The rails* are flat-bottom, and weigh 36 lbs. per yard, but where engines over 12 tons weight are used, or where the traffic is heavy, 42 lbs. rails are substituted. The sleepers are of oak, 7 ft. 3 ins. × 7 ins. × 4½ ins., are packed with 4 ins. to 6 ins. of screened gravel ballast, and the metalling of the roadway is used for top ballast to the level of the top of the rail. The rails are fastened to the sleepers by spikes, coachscrews not being found satisfactory.

*The curves* vary from 44 to 33 yards radius near the towns, whilst in the country, curves of 20 yards are common. The rigid wheel-base of both engine and cars is 5 ft. 3 ins., and the gauge being slightly eased at the curves, it is said the rolling stock passes easily round, with central buffers.

*The gradients* range from 1 in 15 to 1 in 25. The capability of the lines are much restricted by the use of such steep gradients. The locomotives on these gradients have four wheels, and weigh 16 tons, and the limit weight of a train is 35 tons, including the engine; consequently the margin is only sufficient for passenger traffic. In most cases (even at an increased cost for construction), the lines have been laid out for gradients not steeper than 1 in 25. The central rack has only been used in one instance.

The lines are all single, with sidings where necessary, according to the extent of the traffic. The sidings are placed on the side, away from the road, and as the railway companies have no compulsory powers to purchase land, the sidings are placed on public ground.

The stations are of the simplest, generally having a booking-office and waiting-room in a house adjoining, but where no house is available

a small wooden building is erected. Unimportant stations are marked by a signboard, "*Stopping-place.*" The terminal stations are on a larger scale, but still on a simple plan.

Private sidings are very numerous, and give direct communications with farms, fruit-gardens, dairies, mills, factories, ironworks, brick-works, etc., and in a manner prohibitive on ordinary railways. The trucks are loaded direct, and run, without transfer, straight to their point of distribution, while the materials required from the city by the mills and factories are brought in return, with a minimum expense in handling.

The development of this important branch of traffic has led the various companies to facilitate all loading and unloading processes. Bricks and tiles are conveyed in iron cages, in which they are stacked, straight from the field. The cages are transhipped by a crane, and thus conveyed to their destination without one intermediate process of handling. Liquid manure is conveyed in tanks to the railway station, where the tanks are slung by a crane into the railway trucks. At their destination these tanks are either emptied into a storage reservoir, from which the liquid can be drawn off into carts, or else the tanks are taken into the fields on carts. These arrangements are of great importance to agricultural districts, and also permit of the sewage matter being removed to greater distances from the city or towns than would otherwise be possible, except by costly works or by machinery.

The *workshop* accommodation is generally restricted to small repairs required for the maintenance of the engines and cars, whilst extensive repairs are done at outside engineering shops. Some of the companies, however, have large shops, and make their own rolling stock, with the exception of the engines.

The amount of *rolling stock* on each line varies as to mileage and traffic; approximately there are—

Engines	...	...	0·12 to 0·19	per mile worked
Passenger carriages	...	0·3 to 0·6	"	"
Goods	„	0·3 to 0·9	"	"

The *engines* have generally two axles; a few with three axles are employed very exceptionally on steep gradients. They are incased to

within 4 ins. of rail level, to hide all the working parts. They weigh from 8 to 16 tons, the exceptional maximum being 20 tons.

Diameter of cylinders	...	...	7 ins. to 11 ins.
"	...	...	9½ for 12 to 14 ton engines.
Rigid wheel-base	...	...	5 ft. 3 ins.
Diameter of wheels	...	...	1 ft. 11 ins. or 2 ft. 2½ ins.

Neither condensers nor smoke-consumers are used, and Welsh coal is generally burnt.

The *passenger carriages* are both open and closed, providing 16 seats and 16 standing places first class, or a total of 32; 24 seats and 16 standing places second class, or a total of 40; and a composite carriage providing 8 seats and 8 standing places first class, and 12 seats and 8 standing places second class, or a total of 36. Bogie carriages have been tried, but, as a rule, smaller carriages are preferred, as the train is made up more easily to suit the requirements of the moment. The ordinary carriages, standard gauge, weigh on an average 3 to 3½ tons, or 225 lbs. per passenger, and the open cars 2 to 2½ tons, or 157 lbs. per passenger, showing a great advantage in favour of the latter during the season when they can be worked.

The *goods trucks* generally resemble those used on the main-line railways, their capacity ranging from 6 to 8 tons, and their weight, empty, from 2½ to 3½ tons, open trucks, and from 3½ to 4½ tons covered vans.

Continuous brakes are in use in some instances, but hand-brakes are most common, as the low speed of the trains does not justify the adoption of brakes of such a costly character.

The *Government regulations* for the trains to be run on public roads are now, maximum weight of train, including engine, 35 tons, limit of length of train, 6 carriages in addition to the engine for trains running from 10 to 12 miles an hour, and greater latitude if the speed is reduced. The maximum speed allowed is 15 miles an hour, which must not be exceeded; but as allowances for stoppages have to be added, the average speed is less. Experience has shown these speeds to be perfectly compatible with safety on public roads.

The *fares* charged are calculated on the following basis:—

1st class	...	...	...	...	...	0·92d. to 1·07d. per mile
2nd class	...	...	...	...	...	0·61d. to 0·76d. ,

In many cases the actual fares are still lower.

Considerable freedom is allowed in fixing the goods tariff, but in all cases, especially where contracts are made, the rate is very low.

It is difficult to state any average *cost of construction*, as the works on different lines have been carried out under such varying conditions. In some cases it has only been necessary to lay the line, and make good the surface, while in others, streets had to be widened, inclines altered, and, in some instances, deviations from the road have been required, involving special work of a more or less costly character. The approximate cost may be taken as under—

				per mile.
Cost of construction	...	...	£ 320 to 960 average	£ 640
Permanent way materials, and laying	...			960
Land and buildings	...	...	320 to 380	350
Rolling stock	...	...	450 to 570	500
Supervision, compensation, workshops, telegraph, etc.	...	...	100 to 200	150
				<u>£2600</u>
<i>Total per mile</i>				<u>£2600</u>

The average *gross earnings* are about £400 per mile.

The *working expenses* are approximately £300 per mile, or 75 per cent. of the gross receipts, leaving £100 per mile for net earnings, or 4 per cent., nearly, on the capital. This rate has been continued for some time, in face of continued commercial depression, and the railways show signs of more prosperous working conditions in future.

### SAXONY.

*Gauge, 2 ft. 6 ins.; rails, 31 to 40 lbs. per yard.\**

The local railways in Saxony have been constructed on the 2 ft. 6 ins. gauge. The cost of the main lines had been such a serious burden on the finances of the Government that it was absolutely necessary either to stop all further construction by the State, or to adopt a more simple and less expensive mode, and rather than make no more railways, the last-named alternative was chosen.

The first line so made was the section **Wilkau**—**Kirchberg**, rather more than 4 miles long, and opened in 1881. It is mostly constructed

\* *Min. Proc. Inst. C.E.*, vols. lxxxv. and lxxxvi.

along the highway. The distances of all fixed structures are the same as on the standard gauge, to admit of the transport of bulky goods.

The maximum gradient is 1 in 40, and the minimum curve 164 ft. radius.

Level crossings are many, and there are three stations. Fencing and signals are entirely dispensed with, but a telegraph line communicates with the two terminal stations. The traffic is under Government supervision; tickets are issued in the train, and there are only the second and third classes.

The following was the approximate cost:—

								per mile. £
Earthwork	...	...	...	...	...	...	...	144
Bridges	...	...	...	...	...	...	...	340
Permanent way	...	...	...	...	...	...	...	—
Rails 30 to 40 lbs. per yard, with transverse sleepers (carrying 5 tons per axle)	...	...	...	...	...	...	...	770
Ballasting, laying, and packing	...	...	...	...	...	...	...	286
Compensation for road occupation	...	...	...	...	...	...	...	259
Level crossings	...	...	...	...	...	...	...	80
								<u>£1879</u>

The *total cost* of the line is stated to be £23,400, or £5,626 per mile; but this includes the cost of three large stations, the rolling stock, and the connecting of 15 factories with the main line.

**The Zittau Reichenau and Markersdorf Railway.**—This is also a 2 ft. 6 ins. gauge railway, following to a great extent the public road, and is 8·3 miles long. The maximum gradient is 1 in 40, the minimum curve 246 ft. radius.

A Warren girder bridge is erected over the river, of two spans, 74 ft. 8 ins. and 48 ft. 5 ins., with a cylindrical pier 9 ft. 10 ins. diameter. The girders are 7 ft. 6 ins. deep and 11 ft. 6 ins. apart, centre to centre; the weight of ironwork is  $37\frac{1}{4}$  tons, and the cost of the bridge, including erection, was £816, or £6 12s. per lineal foot.

The rolling stock comprises—

- 2 six-wheel engines (15·3 tons each).
- 10 passenger carriages.
- 7 covered goods waggons.
- 28 open goods waggons.

The cost of the line was as under :—

Land	...	...	...	...	...	...	...	...	...	445
Earthwork	...	...	...	...	...	...	...	...	...	678
Level crossings and road bridges	...	...	...	...	...	...	...	...	...	117
Bridges and culverts	...	...	...	...	...	...	...	...	...	432
Permanent way	...	...	...	...	...	...	...	...	...	1422
Signals and cabins	...	...	...	...	...	...	...	...	...	26
Stations and platforms	...	...	...	...	...	...	...	...	...	698
Stream diversions	...	...	...	...	...	...	...	...	...	65
Rolling stock	...	...	...	...	...	...	...	...	...	556
Superintendence	...	...	...	...	...	...	...	...	...	527
Sundries	...	...	...	...	...	...	...	...	...	13
Interest during construction	...	...	...	...	...	...	...	...	...	66
									Cost per mile	<u>£5045</u>

**The Klotzsche-Konigsbruck Railway.**—This is also a 2 ft. 6 ins. gauge railway, of 12·12 miles in length, with a maximum gradient of 1 in 60, and a minimum curve of 328 ft. radius. The goods on this line are transferred to the standard-gauge trucks in other ways than by unloading from one wagon to the other.

One method consists in lifting the body of the normal-gauge wagon and contents off its wheels, and lowering it on to a pair of four-wheeled narrow-gauge lorries, by means of overhead travelling cranes.

Another method is especially suitable for goods requiring careful handling, such as pottery, glass, etc. In this case, the narrow-gauge line is laid for a wagon length down the centre of the normal gauge track, their axes coinciding, but the rails of the former being at an elevation of about 1 foot above the latter. A cradle is then run into position under each of the wagon axles, and they are moved forward together until reaching a short incline (1 in 10 for a length of 8 inches), where the rails of the normal gauge drop about  $\frac{3}{4}$  inch, whereby the axles of the waggons are seated on the cradles.

Each cradle consists of a frame, mounted on four wheels, of 2 ft. 11 $\frac{1}{2}$  ins. wheel-base, carrying a pivoted cross-beam curved down at each end, so as to support the rim of the wagon wheel. This latter method is recommended as much more practical and expeditious than the preceding.

The cost of the line was as follows :—

									£
Land	...	...	...	...	...	...	...	...	170
Earthwork	...	...	...	...	...	...	...	...	318
Fencing	...	...	...	...	...	...	...	...	2
Level crossings and road bridges	...	...	...	...	...	...	...	...	72
Bridges and culverts	...	...	...	...	...	...	...	...	234
Permanent way	...	...	...	...	...	...	...	...	1352
Signals and cabins	...	...	...	...	...	...	...	...	26
Stations, platforms, etc.	...	...	...	...	...	...	...	...	582
River diversions	...	...	...	...	...	...	...	...	6
Rolling stock	...	...	...	...	...	...	...	...	450
Superintendence	...	...	...	...	...	...	...	...	414
Sundries	...	...	...	...	...	...	...	...	13
Interest during construction	...	...	...	...	...	...	...	...	43
							Cost per mile		<u>£3682</u>

**Radebeul and Radeberg Railway.**—This is a 2 ft. 6 ins. gauge railway, and runs through an agricultural district. It is 10·34 miles long, with curves of 246 ft. radius, and gradients of 1 in 60. The arrangements for transferring goods from the narrow to the normal gauge are of a simple character. The transhipment is effected either by a transfer platform, situated between a normal and a narrow-gauge track, with surface inclined transversely, and its edges of a height suitable to the rolling stock of each gauge ; or the narrow-gauge line is raised above the normal gauge track sufficiently to bring the waggon floors of each to the same level.

Narrow-gauge waggons or engines may be run into normal trucks, by an arrangement similar to an ordinary carriage-dock. The locomotives have a wheel base of 5 ft. 11 ins., and weigh 5 tons per axle.

The rolling stock consists of :—

- 3 locomotives.
- 20 passenger carriages.
- 7 covered goods waggons.
- 30 open        ,
- 4 cattle trucks.
- 2 pairs timber trucks.

The cost per mile was as follows :—

									£
Land	...	...	...	...	...	...	...	...	300
Earthworks	...	...	...	...	...	...	...	...	620
Fencing	...	...	...	...	...	...	...	...	2
							Carried forward	...	<u>922</u>

	Brought forward	£
Level crossings and road bridges	...	922
Bridges and culverts	...	177
Permanent way	...	268
Signals and cabins	...	1309
Stations and platforms, etc.	...	24
Rolling stock	...	526
Superintendence	...	690
Sundries	...	476
Interest during construction	...	10
	...	53
	Cost per mile	<u>£4455</u>

There are eight stations on the line.

The Government of Saxony do not hesitate to break the gauge for a short branch of 4 to 12 miles long, in order to cheapen construction, and by so doing they have obtained a cheaper line than by constructing one to carry the main-line rolling stock without transhipment.

The narrow-gauge lines have their own rolling stock for local traffic, and the transported broad-gauge waggons can be coupled either to each other, or to the narrow-gauge stock. The transporters are found quite satisfactory in regard to stability at ordinary speeds, but would not be suitable for carrying live stock or cargo liable to shift. The system may be used with advantage where the narrow-gauge journey is not too long.

#### HUNGARY.

*Gauge, 4 ft. 8½ ins.; rails, 50 lbs. per yard. Gauges, 3 ft. 3⅓ ins., 2 ft. 6 ins., 2 ft. 3½ ins.; rails, 30 lbs. per yard.*

The Hungarian State lines are of three grades, viz.—

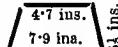
Main lines, 1st rank, with rails	...	...	67 lbs. per yard
Secondary, 2nd	„	„	50 lbs. „
Tertiary lines	„	„	30·24 lbs. „

These secondary and tertiary lines are of standard, metre, and other gauges—

The fish-plates are 12·35 ins. long	and weigh 2½ lbs. each
„ bolts, ½ in. diam.	„ 0·28 „
Bearing-plates under rails, 5 ins. × 5 ins. × 0·2 in.	„ 1½ „

On each side of the rail they have a raised rim 1 in. wide and 0·2 in.

high, and have four spike holes. They are used on curves of 10 chains and flatter, two in each rail length, and in sharper curves four are used.

The rail-spikes are  $5\frac{1}{2}$  ins. long  $\times 0.46$  in. square, and weigh 0.35 lbs. each. The wood cross-sleepers are of oak, 5 ft. 7 ins. long  $\times 5\frac{1}{2}$  ins.  $\times 7.9$  ins.  $\times 4.7$  ins. 

The permanent way for the two grades of local railways in Hungary is as follows:—

	Gauge 4 ft. 8 $\frac{1}{2}$ ins.	Gauge 3 ft. 3 $\frac{3}{4}$ ins.
Rails ... ...	50 lbs. per yard	0.30 lbs. per yard
Fish-plates ...	{13 lbs. outer} {7 lbs. inner }	21 lbs. each
„ bolts ...	$\frac{1}{2}$ lb., 0.62 in. diameter	$\frac{1}{4}$ lb. „
Spikes ...	$\frac{1}{2}$ lb., 5.9 in. $\times$ 0.6 in. $\times$ 0.55 in.	$\frac{2}{5}$ lb. „
Bearing-plates	$3\frac{1}{3}$ lbs., 4.3 ins. $\times$ 5.9 ins. $\times$ 0.3 ins.	$1\frac{3}{4}$ lb. „
Sleepers ...	8 ft. $2\frac{1}{2}$ ins. $\times$ 5.9 ins. $\times$ $6\frac{7}{8}$ in.	5 ft. 7 ins. $\times$ 5.5 ins. $\times$ 

and the weight of iron and steel work per lineal yard of railway is—

No.	Gauge 4 ft. 8 $\frac{1}{2}$ ins. lbs.	No.	Gauge 3 ft. 3 $\frac{3}{4}$ ins. lbs.
2 rails (26 ft. 3 ins.)	879.02	(19 ft. 8 $\frac{1}{2}$ ins.)	376.83
2 inside fish-plates (plain)	14.20		
2 outside „ (angles)	26.22	4	10.05
8 fish-bolts	4.76	8	2.31
6 rail-bearing plates	19.18	2	3.47
42 spikes	21.93	36	12.38
	<hr/> 965.30		<hr/> 425.04
or per lineal yard	<hr/> 110.34		<hr/> 64.72

*The Actual Organization of Local Lines in Hungary, and the Results of their Working, in 1892.\**

In Hungary, as in most European States, the system of main lines is nearly complete. This makes those interested in the construction of railways turn their attention more especially to local lines. The development of the latter during the past few years has received a surprising and unexpected impetus, owing to the sacrifices already made, and still to be made, by the country.

It was about the end of 1860 that local railways began to be constructed in

\* International Railway Congress, London, 1895. Report by E. A. Ziffer.

Hungary. At that time, the Government settled the principles which should influence the construction of lines of secondary category with standard gauge, and of tertiary with narrow gauge. The carrying out of these lines under special regulations has been effected partly by the State and partly by private persons who benefit by them.

But these regulations and special laws did not meet with the expected success. The demand for roads of communication, with a view to constructing on them cheap railways, was renewed to a greater and greater extent; on the one hand, because, in the greater proportion of the country, the byways and highways were either insufficient or were in an almost impracticable condition, owing to want of metal, and the considerable expense necessary to keep them in repair, and, on the other hand, because, in view of the development of agriculture and forestry, and, above all, general industrial impetus, it had become absolutely indispensable to make the conveyance of produce easier by accelerated and economical methods of transport.

It is also to the continuous efforts of municipalities, district authorities, and private persons, that Art. XXXI. of the law of 1880, Art. IV. of the law of 1888, as also the ordinance of the Hungarian Minister of Communications of the 11th of March, 1884, No. 40003/85, concerning railways are due; these laws, or this ordinance, form the basis on which the local system of railways was established, and has since been developed.

These legal steps were all the more approved of in that the facilities and favours accorded to the new means of communication put an end to the insufficiency of communication between the different districts of the country, some of which had been absolutely isolated from all commercial interchange.

The two articles above mentioned arranged for the financial co-operation of the State, the municipalities, the district authorities, and private persons, at the same time insuring that the undertaking of secondary lines should be encouraged by various advantageous inducements. The chief provisions may be summarized as follows:—

The State allows to local railways for a period of thirty years exemption from stamp-duties and all taxes direct and indirect; frees them from contributions towards the expense of the collection of customs, from the cost of police, of river and canal repairs (Art. XXXI. of 1880, secs. 5 and 6, and Art. IV. of 1888, secs. 4 and 5), and grants them besides the following concessions:—

1. Where a line of railway serves the property of the State held in its own hands, the State will contribute to the cost of its construction. (Art. XXXI. of 1880, sec. 7.)
2. The Minister of Commerce shall have the right to grant a provisional subsidy for a period of fifty years in return for the carriage of the mails. This subsidy shall be double the sum economized by making use of the railway, but with the provision that the sum capitalized at 5 per cent. shall not exceed 10 per cent. of the actual cost of constructing the railway. (Art. IV. of 1888, sec. 4.)
3. The Minister of Commerce shall be authorized to debit the annual budget of the State with a sum of £25,000, as subsidy for local railways, so that an enterprise of this kind may be subsidized to the extent of 10 per cent. of the original capital. (Art. IV. of 1888, sec. 7.) This grant shall not prevent the subsidies being increased by special Act of Parliament.
4. The Hungarian State railways shall carry materials for the construction of local railways at actual out-of-pocket expenses. (Art. XXXI. of 1880, sec. C.)

5. The Hungarian State railways locomotive works, as also the State factories at Disegyör, shall be permitted to give several years' credit for supplying engines and iron and steel materials required for the construction and working of local railways. (Art. IV. of 1888, sec. 6.) At a moderate rent, the State railways shall supply rolling stock for such local railways as they shall work.
6. The Hungarian State railways, as also all the State guaranteed private lines, are bound to take over, if requested, the working of local lines which connect with their lines, on condition that they shall receive compensation if the actual working expenses are not covered. (Art. XXXI. of 1880, sec. 8, and Art. IV., 1888, sec. 6.)
7. This article authorizes the Minister of Commerce to refuse, moreover, to allow local lines for which those benefiting by them shall not have contributed at least 25 per cent. of the original capital to be opened. The municipalities and the district authorities are also authorized to contribute funds towards the construction of local lines, and also to levy special taxes for this purpose. (Sec. 7.)
8. The minister shall be entitled to demand that the working of a local railway shall be handed over to the railway with which it connects, if the latter belong to the Hungarian State, or to a private State-guaranteed railway. (Art. IV. of 1888, sec. 6.)
9. The actual construction capital shall be fixed by the Act of Concession; the nominal capital, the method and conditions of its subscription, the kinds of stock to be issued, and their respective relations to each other; and, lastly, the dividends and fixed interest shall be settled by the Minister of Commerce. (Art. IV. of 1888, sec. 10.)
10. The rates (maximum) shall be fixed in the Act of Concession. The State shall have the right to demand the reduction of rates, if the net profit of a line for three years in succession reaches 7 per cent. on the original construction capital. (Art. XXXI. of 1880, sec. 12.)

Finally, a ministerial ordinance of the 11th of April, 1889, fixes the regulations concerning the construction, equipment, and plant of standard-gauge local lines.

The following table shows the development of local lines in Hungary, due to the laws which have been mentioned:—

Years.	Mileage Average open.	Total gross receipts.	
		Annual.	Per mile.
1888	miles 1144	£ 280,537	£ 245
1889	1315	329,063	250
1890	1640	385,113	250
1891	1799	480,833	267
1892	2138	573,188	268
1893	2333	662,852	284

The figures in this table show that the mileage of local railways open has increased 103·8 per cent. from 1888 to 1893, and the gross receipts 136·3 per cent.

According to a brief account published in the *Zeitschrift für Eisenbahnen und Dampfschiffahrt*, Nos. 8 and 9, of 1894, by Count Edward Wilezek, and based on official statistics, the Hungarian local railway systems comprised, for 1892, sixty lines open, with a total mileage of 2326 miles, of which 116 (5·1 per cent.) were narrow gauge; and nine lines in course of construction, with a mileage of 327 miles, of which 48 miles (14·7 per cent.) were narrow gauge. This makes a total of 2653 miles, of which 164 miles (6·2 per cent.) will be narrow gauge.

Authority was given in 1893 to proceed with estimates and preparatory works in connection with 68 new local lines with a total mileage of about 2125 miles, so that ere long the local railway systems will be considerably extended; for if these projects are carried out they will embrace 208 lines with a total length of about 7000 miles.

Besides these local railways there are also in Hungary industrial lines with a total length of 954 miles, of which 43·1 per cent. use locomotives for traction, and 56·9 per cent. horse traction. These industrial lines are subdivided as follows, according to their use:—

31·7 per cent. for working mines; 35 per cent. forests; 14·6 per cent. agriculture; 13·7 per cent. for working industrial factories; 5 per cent. various.

There are besides lines on roads (tramways) with a total length of 99 miles, of which—

65·1 per cent. are worked by horses; 27·4 per cent. are worked by steam; 7·5 per cent. are worked by electricity.

The local railways open at the end of 1892 represented 30·45 per cent. of the system of the Hungarian railways, which comprise 7539 miles, of which only 132·5 (5·7 per cent.) are narrow gauge; namely, 115·5 of local railway, and one main line of the third class with 14·5 miles. The narrow gauge used has been 29·5 ins., 29·9 ins., and 39·37 ins.

The original working capital of the 60 local lines open, and of five others not yet opened for traffic at the end of 1892, amounted to £10,696,430, to which the State has contributed 13·3 per cent., the municipalities 7·5 per cent., the district authorities and private persons 12·4 per cent., making altogether a total of 33·2 per cent. So the public contributions amount to £3,557,653, and the share subscribed by private enterprise to £7,138,777, or 66·8 per cent.

In other terms, the subscriptions may be divided thus—

(a) The State—

					per cent.
Subscriptions for carriage of mails capitalized	...	...	...	...	5·6
," and other contributions	...	...	...	...	7·7
Total					13·3

In return for these sums, amounting to £1,430,657, the Government received the sum of £1,231,016 (86·4 per cent.) in ordinary shares. The State, therefore, has given as an out-and-out contribution, £199,624, or 13·6 per cent.

(b) The municipalities—

Subscriptions amounting to £794,870 (78·1 per cent.), and a sum of £175,312 (or 21·9 per cent.), which must be considered as an out-and-out contribution.

The number of ordinary shares issued is divided as follows :—

							per cent.
To the Government	...	...	...	...	...	...	26·9
,,  municipalities	...	...	...	...	...	...	15·1
,,  district authorities	...	...	...	...	...	...	11·3
						Total	53·3

The remaining 46 per cent. is in the hands of the private persons who benefit by the introduction of the lines.

The nominal original capital, £10,300,000, for the 2326 miles of local railway at the end of 1892 is composed of the following shares :—

per cent.
2·83 bonds.
60·61 preference shares.
36·56 ordinary shares.
<u>100</u>

The average market quotation of these shares is 84·6 per cent.

The average cost of construction and equipment of these lines was, at the end of 1892—

	per mile.
	£
For standard-gauge lines	4124
,,  narrow-gauge lines	3394

It must be remembered that the cause of this first cost being, as it appears, relatively small, is due to the fact that the greater part of the rolling stock of the lines in question was provided not by the enterprises themselves, but by the railway administrations who worked them.

The working of the 60 lines at the end of 1892 was carried out as follows :—

	Number of lines.	Miles.
(a) By the enterprise itself	...	9 442·5
(b) By the administration of the private railway with which it connects	...	7 142
(c) By the administration of the State railways at the expense of the enterprise	...	3 146
(d) By the administration of the State railways at its own expense	...	5 115·5
(e) By the State railway administration on a basis of ordinary working agreements	...	31 1302
(f) By the State railway administration as proprietors of the line	...	5 178
	<u>60</u>	<u>2326</u>

The rolling stock belonging to all these lines consists of—

108 engines,  
236 carriages,  
1714 goods wagons.

that is—

0·046 engines	per mile
0·101 carriages	"
0·73 goods waggons	"

The gross receipts of the 60 lines on the average, at the end of 1892, worked were—

		per mile. £
(a) From passengers, baggage, and parcels	...	106
(b) From goods	...	183
(c) Various	...	13
		<u>£302</u>
		<u>  </u>

The *number of passengers* carried per mile has been 3680, and tons of goods 1529.

The *gross receipts* varied between £806 per mile (Budapest-Szt. Lörincz) and £17 per mile (Harazti-Raczkeve).

The *average expenses* amounted to £165 per mile, i.e. 54·7 per cent. of the receipts. This percentage varied from 36·1 per cent. (Hermanstadt-Felcke) to 89·5 per cent. (Kesmark-Szepesbála).

The *interest on capital* amounted to 3·31 per cent. on the average. This interest varied in the case of the different lines as follows: Budapest-Szt. Lörincz (narrow gauge), 11·6 per cent.; two others, 6·9 per cent. to 7·2 per cent.; seven others, 5·2 to 5·9 per cent.; eight others, 4 to 5 per cent.; ten others, 3 to 4 per cent.; thirteen others, 2 to 3 per cent.; seven, 1 to 2 per cent.; three, 1 per cent.

The relatively satisfactory return on the capital of the total number of lines is due partly to the sufficiently high passenger and goods rates charged, and partly to the working agreements entered into with the State railways. According to these agreements, the State receives a fixed sum per passenger mile and per ton mile of goods. Hence, in every case, some profit cannot fail to accrue unless the private companies spend sums above and beyond working expenses properly so-called.

The allowance paid consists for passenger traffic of 50 per cent. of the gross receipts; in the case of goods traffic, it consists of a fixed terminal charge in addition to 0·8 pence per kilometric ton per mile for smalls, and 0·32 pence per ton mile in the case of a full load.

When the rolling stock of the line is supplied by the administration which guarantees to work it, the proprietary company has to pay to the administration which works the line 10 per cent. of the gross receipts, exclusive of terminals.

The passenger tariff amounts in most cases to—

		Pence per mile.
1st class	...	1·6
2nd class	...	0·96
3rd class	...	0·64

The goods tariff shows on the average the following rates—

*Grande vitesse.*

		Pence per ton-mile.
Class I (ordinary)	...	5·44
Class II (reduced)	...	4·48
Class III (specially reduced)	...	3·2

Petite vitesse.										Pence per ton-mile.
1st class	...	...	...	...	...	...	...	...	...	2·8
2nd class	...	...	...	...	...	...	...	...	...	1·9
Specially cumbrous goods ( <i>encombrantes</i> )										3·8
Class A	...	...	...	...	...	...	...	...	...	1·6
Class B	...	...	...	...	...	...	...	...	...	1·4
Class C	...	...	...	...	...	...	...	...	...	1·1
Special rate No. 1	...	...	...	...	...	...	...	...	...	1·3
Special rate No. 2	...	...	...	...	...	...	...	...	...	1·1
Special rate No. 3	...	...	...	...	...	...	...	...	...	0·8

The terminal charge for goods at "grande vitesse," and also for the goods called "encombrantes," and of the 1st and 2nd	Pence.
class, "petite vitesse," is per ton	...
Class A	...
Class B and C	...
Special rate No. 1	...
Special rate No. 2	...
Special rate No. 3	...

It is worth noticing that the Hungarian zone tariff system already in use on some local lines seems to succeed, and to be extending more and more, several of the lines having introduced it at the beginning of this year (1894).

Nevertheless, it must be noted that, in spite of the subsidy provided by the Hungarian State railways, by means of working agreements, and amounting to the sum of £25,000 at least, still the nett proceeds of the local railways are insufficient to meet the interest on preference shares, and the ordinary shares bear, as a rule, no interest.

These circumstances make one pause to consider how the interest on the capital expended on these lines can be increased.

The first thing to be done is to bring about economies in working, and this, to my mind, necessitates the working of them being leased, as State working is too much tied and bound by regulations, and lacks elasticity. The State cannot but gain by giving up the present method, which, according to all accounts, weighs heavily upon its shoulders.

The matter has received much attention amongst those concerned, and it is recognized that the introduction of leased working would cause some difficulty for the small enterprises, especially on account of the absence of rolling stock; but all the actual inconveniences of working by third parties could be easily obviated in the new agreements; there would also be an opportunity of exercising an influence on the returns of a railway by carefully estimating, with a view to economy, the capital required for original construction.

Economy in original expenses will only be attained by the adoption of narrow gauge. For the first time in Hungary, a project of a local narrow-gauge system confined to the north-west of Hungary was agreed upon in 1892. This is all the more important from the fact that the mountainous regions of the north and east of Hungary are insufficiently provided with these means of transport.

The first Hungarian local line was the Pressbourg-Tyrnau with 39·7 ins. gauge, and traction was by horses. This line was altered to standard gauge on the

introduction of locomotive traction ; then, in 1872 and 1873, came the local standard-gauge railways of the Austro-Hungarian Privileged Company, and also those of the Hungarian State railways themselves.

The establishment of local railways with the reduced gauges of 29·52 ins. and 29·92 ins. only dates from the last two years. Amongst these is the Budapest-Szt. Lörincz, on level ground, which has been mentioned above as having heavy passenger and goods traffic, and as paying the largest dividend of all the Hungarian local railways. *This speaks eloquently in favour of the narrow-gauge system.*

The standard gauge has been especially used on the local lines situated in broad and fertile plains, and for these this gauge seems eminently suitable. Moreover, the old rolling stock of the main lines can thus be employed.

In the course of 1893, the development of local lines in Hungary received a further impetus, and a certain number were opened for traffic. This beneficial activity has been extended into the current year.

It is no less interesting to note the experimental introduction of electric traction in the working of the Arad-Csanad local lines, an important system of 201·5 miles, which earned in 1892 £456 per mile, and paid 5·8 per cent. interest on its original capital. This company leases the working of its lines.

Should electric traction give good results, a new era will open for local railways, an era the results of which, considered both from the economical and technical standpoint, will be extremely advantageous.

Local railway construction has been markedly encouraged by the formation in 1892 of the Hungarian Local Railways Trust Company. This company's object is to buy, to sell, and to mortgage the bonds and shares belonging to the companies of local railways opened or being constructed in the Hungarian kingdom and in the neighbouring countries. It also intends to issue bonds bearing fixed interest to the amount of the shares of these railways which it has taken up either in its own name or by mortgage.

Quite lately this company has acquired and mortgaged preference shares of six different local railways to the amount of £344,000. The total mileage of these is 243 miles. The society has issued 4½ per cent. bonds to the extent of £425,640.

It is clearly seen from what has just been said about the development, organization, and results of working of the Hungarian local lines that, in conjunction with the State, the municipalities, the district authorities, and private persons who benefit thereby, evidently aid the establishment of new lines and diligently support these enterprises afterwards.

Private enterprise assists in the construction of these railways to a not less marked extent.

Nevertheless, it must be recognized that the bulk of traffic is not very great, and that the working expenses are too high, in spite of the favourable agreements. The main object to attain is, then, to find means of decreasing these expenses.

I do not doubt that this result can be obtained by the co-operation of all the interested parties, if it be admitted that these lines, which have to satisfy not only local necessities, but also more extensive demands, must be worked under other conditions than those obtaining at present.

Local railways have an important influence on national prosperity, but will only continue to develop if they enjoy full and complete liberty in construction, working, and, lastly, in administration ; in a word, *if they are constructed, organized, and administered on a different system from that customary in the case of main lines.*

TABLE K.  
PARTICULARS OF COST, REVENUE, EXPENDITURE, AND INTEREST PAID ON SOME RAILWAYS IN HUNGARY.

## FRANCE.

**Light Railway from Caen to Dives and Luc-sur-Mer.**

*Gauge, 2 ft. 0 ins.; rails, 30 lbs. per yard.*

## PLATES XXIII., XXIV., XXV.

One of the most successful local railways on the Continent is that constructed and worked by the Decauville Company, on their system of steel sleepers riveted to the rails. It is of 2-ft. gauge, and runs partly alongside a road or canal for the whole of its length. The works are of a permanent and substantial character, and this line affords a good illustration of the class of railway which will best meet the requirements of local districts, in our own country and in the colonies.

*The rails* are of steel, weighing 30 lbs. per lineal yard, and are riveted to steel sleepers weighing 31 lbs. each. The line is well ballasted and constructed in a thoroughly substantial manner, and has cost £2143 per mile, including rolling stock. There are fifteen stations in the  $23\frac{1}{2}$  miles, and each station has cost £160. There are also large goods depôts at Riva-Bella and Dives, extra sidings at three different points for interested landowners, and signals and telephones with return wires.

These items have added considerably to the cost, and in many districts would not be required. Had they been omitted, or, at any rate, very considerably reduced, the cost of the line would have averaged about £1930 per mile.

The *locomotives* weigh 12 tons in working order, carrying 300 gallons of water, and  $\frac{1}{2}$  ton of coal, and are capable of hauling 180 tons gross load on the level at  $7\frac{1}{2}$  miles per hour.

The *rolling stock* is of the bogie type, fitted with vacuum brakes, and the goods waggons have a carrying capacity of three times the tare (16 cwt.).

The *passenger carriages* are of various descriptions, and, when divided into compartments, each compartment accommodates four persons on either side; they are 30 feet long, and the—

1st Class carriage holds	...	...	...	...	40 passengers
2nd        "	"	...	...	...	48        "
3rd        "	"	...	...	...	56        "

1st Class tram-car holds 8 each side, and has a balcony at each end.

3rd Class tram-car holds 10 each side, and has a balcony at one end, and a luggage compartment at the other.

As many as 350 passengers have been conveyed by a single train.

Empty trucks are always run in the rear of the train for convenience of shunting at roadside stations. They are uncoupled from the train, and hand-shunted into a siding, when the train has left.

All transhipping is done by hand, the trucks of the normal and narrow gauges being brought side by side, with the floors of the trucks level. The cost of this work is 2d. per ton, and is paid by the receiving company.

The passenger fares are per mile—

1st Class		2nd Class		3rd Class
2d.		1½d.		1d.

with 50 per cent. additional for return tickets.

The total cost of the railway has been £50,594; the total receipts for 1894 were £8473, or £360 per mile per annum; the working expenses £4407, or £187 per mile per annum; leaving a balance of £4066, paying 8 per cent. on the capital.

The working expenses per cent. of gross receipts were 53·4.

Nearly 300,000 passengers were carried over the line last year, and as many as 61,405 in one month.

#### **Light Narrow-gauge Railway from Pithiviers to Toury in France.\***

*Gauge, 2 ft. 0 ins.; rails, 19 lbs.*

The line has been built by the Council of the Department, and is worked on lease by the Decauville Company, on the following terms :—

If the gross receipts are less than £116 per mile per annum, the Department has to pay the lessee half the difference.

If the gross receipts are more than £148 per mile per annum, the lessee pays half the difference to the Department.

\* *Min. Proc. Inst. C.E.*, vol. cxviii.

PLATE XXIII.



IMP. PHOTO. SPRAGUE & CO. LONDON

CAEN TO DIVES AND LUC-SUR-MER RAILWAY. GAUGE, 2 FT.

PHOTO FROM OSCARVILLE CO

[Between pp. 144 and 145.]



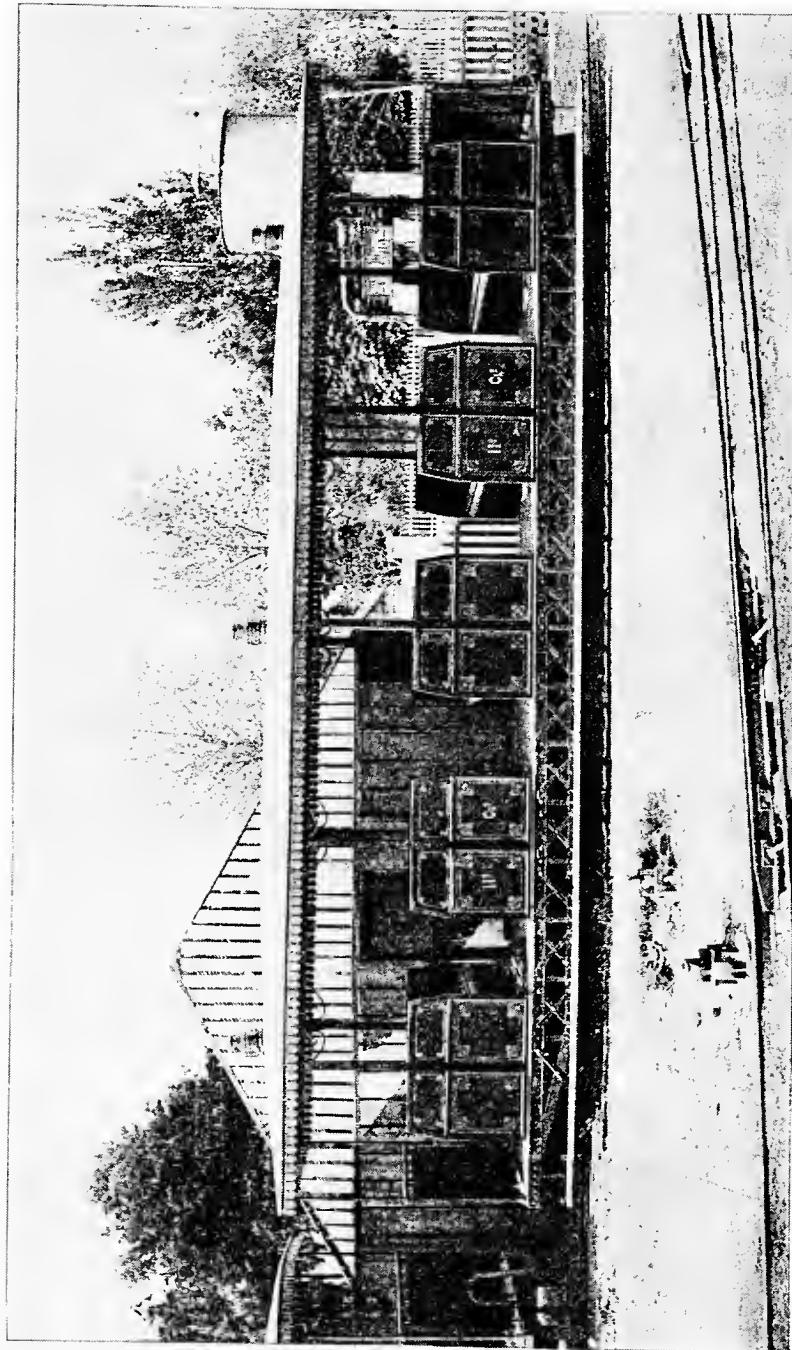


IMPHOTO SPRAGUE & CO LONDON

CAEN TO DIVES AND LUC-SUR-MER RAILWAY. GAUGE 2 FT

[Between pp. 144 and 145.]





CAEN TO DIVES AND LUC-SUR-MER RAILWAY. GAUGE 2 FT.

LINK PHOTO SPRACRE & CO LONDON



When the gross receipts are between £116 and £148 per mile, no payment is made either way.

The Department hoped to make a considerable saving in road maintenance by the construction of the railway. The line is laid alongside the public road, is 19 miles long, and has been increased in length to take in as much local traffic as possible. There are seven intermediate stations, and six other stops, to pick up passengers without luggage. An open shed, and a small office for parcels and for a weighing machine, are the only accommodation at stations. Tickets are issued on the train by the guard.

The steepest gradient is 1 in 100. The rails, 19 lbs., are found to be too light—24 lbs. would have been better—and are riveted to steel sleepers.

There are four engines, two for goods, weighing each 12 tons in working order, on Mallet's compound system, and two passenger engines, weighing each  $8\frac{1}{2}$  tons in working order.

There are two types of waggons: 10-ton open bogie waggons, weighing 3·17 tons, and 5-ton beet-root waggons on four wheels, and a cattle waggon, 32 ft. long, on bogies.

Cost of construction	...	...	...	...	...	£1223 per mile.
Rolling stock	....	...	...	...	...	328 "
						<u>£1551</u>

The line carried in 1893, 27,255 passengers, and earned £2086, or £109 12s. per mile per annum.

The principal object of the line is to assist the cultivation of beet-root and the manufacture of sugar.

Important branches have been laid down by cultivators and manufacturers, and this is easily done when this type of line is used. It can be laid and moved as the gathering of crops may require.

#### STATE SUBSIDIES TO LIGHT RAILWAYS.\*

Under this title, my contemporary, the *Voie Ferrée*, has recently published a most admirable article signed "Rossely." In view of the Board of Trade Conference and of the fact that our public authorities will undoubtedly be asked before long to consider the whole question of assistance to light railways, I think the article should be of very considerable interest in England, though I confess to feeling the

\* *Transport*, Nov. 23, 1894.

contrast between the scientific manner in which these matters are studied in France, and the happy-go-lucky method in which our Irish light railway guarantees were given, as somewhat humiliating. I therefore translate it, not in full but in a somewhat free rendering, omitting passages which have merely local application, and where necessary turning French phrases and conditions into their English equivalents:—

It may be said in general that all methods of assistance to light railways can be divided into two categories: a guarantee of interest and a fixed subvention.

### 1. *Guaranteed Interest.*

This was the method adopted by the law of June 11, 1880. The promoters of the line build it, and furnish the rolling stock, at a fixed price either for the whole line or per mile, the State and the Department concerned paying interest on the sum so fixed at a prescribed rate. The promoters work on certain terms, which consist of a fixed sum and a proportion of the gross receipts, the State and the Department guaranteeing that the receipts shall not fall below a certain minimum; in other words, undertaking to pay the difference when the gross receipts do fall below that minimum. This system has been adopted both in Algiers and Tunis, and on the systems of Le Sud de la France, Les Chemins de Fer Départementaux, Les Chemins de Fer Economiques. There has been a great outcry against this system, on the ground that it gave the promoting Companies a considerable profit on the cost of construction, and that by guaranteeing to them a minimum receipt per mile the State encouraged them not to develop the traffic. The point has even been carried further, and it has been said that, as each increase in receipts implied an increase in the cost of working, the Companies had an interest in not developing the traffic; and this idea has found expression in the very grave accusation phrased as “working for a deficit.” This much is certain, for it is plainly to be seen in the accounts of the Companies which have built on the guarantee system; the State and a certain number of Departments have, in consequence of the guarantee, to support every year considerable charges largely in excess of what was anticipated. These excesses fall mainly on the Departments, as the State took the precaution to limit its share in the guarantee to a fixed maximum. This unfortunate result is due to several causes. The Departments, which were the first to encourage light railways, had not a sufficiently accurate idea of the probable receipts of the lines which they caused to be constructed, and made serious mistakes in their calculations. At that period there was not sufficient practical experience of the actual cost of working light lines, and by comparison with the cost of ordinary railways, a figure quite unnecessarily high was assumed. Accordingly the guaranteed minimum of earnings per mile was fixed much too high. Further, the cost of construction was also fixed by comparison with the money spent by the great Companies or on lines built by Government engineers on a quite unnecessarily magnificent scale. In one word, *sufficient allowances were not made for the essential differences which ought to exist in the expenditure of an ordinary railway, and those of a light railway of metre gauge.* Yet again, at the time that these lines were promoted, the interest on money was much higher than to-day, when it is scarcely 3 per cent., and the promoting Companies get the advantage of the difference. All these causes combined have been in favour of the Companies, while, on the other hand, certain Departments have seen their rates increase to an alarming extent, and have uttered a cry of alarm which has been re-echoed all through France. The Minister of Public Works and the Council

of State naturally desired to prevent the evil extending, and have accordingly substituted the system of fixed subsidy for the system of guaranteed interest.

## 2. *Fixed Subsidy.*

The first reform was to put a stop to the lump-sum price for building the line. The Council of State has absolutely insisted on this in all recent concessions. This reform is entirely in the right direction. The second reform consists in putting an end to a guaranteed minimum sum for working expenses, for this is, in other words, a lump-sum price for working even more harmful than the lump sum for construction. Let us now proceed to examine some of the various solutions either adopted or proposed, and point out that which seems the best.

### First Solution.

The cost of construction of the lines is estimated by engineers in the public service as exactly as possible. The Department gives to the Company that builds the line a *fixed subsidy per mile built, usually about three quarters of the cost*. The Company supplies the balance, and carries out the works under the control of the county engineer. Plainly this is, though disguised under a different shape, a lump-sum subsidy for construction. The Company works at its own cost and risk during the whole term of the concession (ordinarily on the average about ninety years). It keeps the entire earnings so long as the gross earnings, after deducting rates and taxes, do not reach a certain fixed maximum. When the gross receipt exceeds the maximum, it receives as cost of working a certain sum fixed according to the formula—

$$W = F + x R.$$

Where  $W$  is the working cost,  $F$  is a fixed sum which differs on the different lines, and is calculated as sufficient to cover the whole of the fixed costs\* of working the line,  $R$  is the gross receipts less rates and taxes, and  $x$  is some fraction of the gross receipts varying in practice anywhere between one quarter and three quarters.

The Company on this system takes the risk of the construction cost exceeding the estimate, and naturally, therefore, tries to build as cheaply as possible. But the works are carried out under the control of the county engineer, and further, the Company has an interest in building honestly, and avoiding scampiog, from the fact that the cost of repair will fall on its shoulders; and, further, the working expenses, for which the Company is responsible, would be heavier on a badly constructed line. This system, therefore, is a considerable protection to the Departments, but in order that the line may continue in a satisfactory condition, it is necessary that its earnings should be sufficient to cover, first, the interest on the sum which the Company has actually spent; and second, the actual cost of working. If, therefore, a Company has committed itself to poor lines whose earnings only increase very gradually, a time may come when the Company, after having spent all its capital in meeting the deficits in the working expenses, will be obliged to go into liquidation and abandon its undertaking. The Department, it is true, will then enter into

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\* Foreign railway economists always distinguish between "fixed costs," expenses for maintenance, signalling, station staff, etc., which remain in great measure the same whatever be the traffic, and "variable costs," such as locomotive and train staff expenses, which increase roughly proportionately to the traffic.

possession of the line and the rolling stock, but unless it has been very careful to see that they were properly maintained, it is quite possible that their actual value will turn out to be less than the sum which the Department has paid as its share of the cost of building. At best it will be forced to work the line itself, which is hardly practicable, or to apply to some other Company to work it, which may demand an extravagant price.

For certain lines this system has been combined with a fixed and guaranteed minimum of working expenses. Here we come back to the difficulty mentioned above in the case of guarantees of interest.

### Second Solution.

The Department in this case built the line and supplied the rolling stock at its own sole cost, and then leased it to a contractor, who undertook to work it on the following conditions :—

If the gross receipts, after deducting rates and taxes, are less than  $x$  fr. per mile, the  $x$  fr. are regarded as the cost of working. The line is then considered as not paying its working expenses, and the Department pays the contractor half the difference between  $x$  fr. and the actual gross receipts. If the gross receipts are more than  $x$  fr., but less than  $x + y$  fr., the contractor keeps the entire earnings. If the gross earnings are more than  $x + y$  fr., the contractor receives as his remuneration for working half  $x + y$  plus half the gross receipts, after deducting rates and taxes. The balance is employed to repay, with interest at  $4\frac{1}{2}$  per cent., in the first place to the contractor, and secondly to the Department, the original deficits, if any, in the working expenses, and after this to repay the Department for its original capital expenditure. In the case of the Pithiviers to Toury, the value of  $x$  was taken as £120 per mile per annum, and the value of  $y$  at £32 per mile. This was allowing for three trains each way daily. In other words, the line would pay its working expenses if the receipts per train mile do not fall below

$$\frac{\text{£120}}{6 \times 365} = 13d. \text{ per train mile.}$$

This line is worked by the Decauville Company.

Under this system, the contracting Company has every interest in increasing the traffic as much as possible. Further, it only bears half the loss if the receipts at the outset are insufficient. In order to oblige the contracting Company to maintain the lines in a satisfactory manner, a very large deposit is required, which is forfeited to the Department if the contracting Company fails to carry out all the obligations in its contract, and the lease has to be cancelled. Finally, this lease is only granted for 15 years, so that the Department and the Contracting Company may not be bound to one another for too long a period. This system is ingenious, and the Department has deliberately faced the necessity of employing a contracting Company—a thing which, as has been said above, a certain number of the Departments will be forced to accept sooner or later. At the same time, to my mind, there is a serious objection, namely, that the Department builds the line itself. On the other hand, in requiring the contracting Company to build on a schedule of prices fixed by the public engineers, and with as complete and strict a supervision as possible, there are the following advantages :—

- (1) There is no risk of taking a contract for building by public tender from an unsatisfactory contractor.
- (2) Accounts are much more easily settled, whereas, unfortunately, it very often

happens, in spite of all care taken, that contracts let by public tender lead to disputes and interminable litigation before the Prefectural Council and the Council of State.

(3) The Department has the best guarantee of good workmanship in the fact that the contracting Company has to work the lines for a considerable number of years, and consequently is interested in the line being well constructed, and requiring in the future as little maintenance and repair as possible.

(4) The building of the line is facilitated because the contractor, if he has got to work it afterwards, can use the road and rolling stock to carry out the works.

(5) It is accepted as reasonable in the abstract that a contractor should always get a fair profit on the work, and it is only right that the Company which is to work should get this profit, so as to counterbalance, to a certain extent, the risk which it must run in working later on.

(6) Finally, the system of allowing the Company which is to work, to build also, avoids all the difficulties that a working Company might raise on taking over the line. The engineers who have built on behalf of the Government, lines which have subsequently been handed over to the great Companies to work, know how there are questions of all kinds raised when these lines, however well constructed, are handed over. Further, if by chance an accident happened immediately after the line was opened, the working Company would not be able to attribute this to some imperfection in the line for which it was not responsible.

### Third Solution.

The lines are laid out and the cost estimated by the county engineers. This cost is estimated both per mile and for the entire line. The Department, with the help of the State subsidy, makes itself responsible for the greater part of the expense. The Companies who are inclined to bid for the concession examine the estimates and plans of the engineers, make their own calculations, and put in a tender in which they undertake:—

(1) To build the lines either for a price per mile, or for a lump sum which they put into their tender. In other words, they undertake to do the work at a certain discount off the price as estimated by the county engineer.

(2) They offer to work at a certain price, which they also put into their tender in the form of a lump sum per mile, plus a definite percentage of the gross receipts.

This system is in fact a lump-sum contract both for construction and working, a system which to my mind the Council of State ought to put a stop to. The Department examines the tenders and hesitates between them; on the one hand, between the various discounts offered on the cost of construction; on the other hand, between the advantages which one tender for working offers over another. Too often the Department decides not according to the business or financial capacity of the tenderers or their reputation, but according to the economies which it expects to make later on in the working expenses; economies which probably will never be realized in practice. Under this system the tenderers may very likely themselves be in error as to the probable earnings, and may undertake to do the work too cheaply, and it is quite likely that later on a working Company will be compelled to abandon the undertaking to the very great injury of the Department.

### Fourth Solution.

The construction costs are estimated by engineers as exactly as possible, and with the help of a schedule of prices, which takes a liberal view of the cost and of the interest of the constructing Company. The Company executes the works under the control of the county engineers on a schedule of prices, but with a fixed maximum for the line or lines included in the concession. The object of fixing a maximum sum is this:—The accounts are settled after measuring up the work actually executed and charging them out at the schedule rates. If the result so arrived at is less than the fixed maximum, one-third of the difference goes to the Department and the remaining two-thirds to the constructing Company. If, on the other hand, the maximum is exceeded, the entire loss falls upon the Company. In contracts drawn after this model the Department undertakes to bear the entire capital expense, and in order to deter contractors or contracting Companies who are untrustworthy, or with insufficient capital, from tendering, it has recourse to the following expedient: Only three-quarters of the total expense are paid straight out; the remaining quarter is advanced by the contractor, and is either held as caution money or employed straight away on the works, being only paid by the Department to the contracting Company at the end of the concession. But during the whole time of the concession it bears interest at the rate of 4 per cent. The working Company works at its own cost and risk. There is a fixed maximum for working expenses laid down in the concession. If this maximum is not attained the working Company receives as a premium two-thirds of the difference between the maximum, and the actual expenditure. If the gross receipts are inferior to the maximum laid down for working expenses, the deficiency is carried to a suspense account. If the receipts are larger than the expenses, the balance is, in the first place, devoted to paying off the deficiencies carried to suspense account, with interest at 4 per cent., and after this has been done is divided equally between the Department and the working Company. This system has been adopted by two light railways recently sanctioned in the Department of the Loire. In that case the actual figures were as follows: As long as the receipts are less than £192 per mile per annum, the maximum for working expenses is fixed at the same figure. When the receipts exceed this amount, the maximum is fixed by the following formula:—

$$W = \text{£}93 + \frac{1}{4}d. T + 3d. M + 0.30 R.$$

In this formula  $W$  is working expenses, £93 is the fixed payment per mile per annum, the next item is one farthing per ton mile, the third  $3d.$  per train mile, and the last item the percentage of the gross receipts less rates and taxes.\*

This system seems to me the best of all that have been adopted up to the present time. It protects the interests of the Department, and at the same time encourages the working Company to develop the traffic by giving it reasonable working expenses, which increase as the tonnage and the gross receipts increase. I may say further that this formula is practically that recommended by Messrs. Colson and Considère, and even at the risk of slight additional complication, it seems to me desirable to add an additional term taking account of the passenger miles as

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\* The allowance paid to the contractor for working expenses per mile will be as follows: A fixed sum of £93 per mile per annum  $+ \frac{1}{4}d.$  per ton of goods carried over that mile  $+ 3d.$  per train mile over it  $+ 30$  per cent. of the gross amount earned on that mile.

well as the ton miles. A further advantage is that the working Company may fairly hope that when the traffic develops it will repay the deficiencies in the earlier years if there were any. The only inconvenience—and it is an inconvenience common to all contracts where the working Company works at its own risk—is that a contractor may have undertaken an unproductive or only slightly productive line, and in this case the time may come when the accumulated deficiency in receipts will have eaten up the entire capital of the working Company and it will be forced into bankruptcy.

## PRUSSIA.\*

*Gauge, 1 ft. 11½ ins.; rails, 19 lbs. per yard.*

EXPERIENCE OF THE PRUSSIAN RAILWAY DEPARTMENT IN THE CONSTRUCTION OF  
NARROW-GAUGE RAILWAYS.

The trials which for a number of years have been made by the Prussian Railway Administration in the construction and working of narrow-gauge lines of 60 centimetres (1 ft. 11½ ins.), have proved the efficiency and safety of these lines for passenger, as well as for goods traffic. These lines are also largely used for military purposes, where speedy construction and the greatest simplicity and lightness of materials are the important factors, and have proved themselves perfectly adequate.

The smallest admissible radius for the main-line curves is 98 feet; sharper curves would necessitate a more complicated construction of the locomotives. The wheel-bases of the waggons are so dimensioned that curves up to 33 feet radius can be traversed; this enables sidings to be readily and economically laid to agricultural and industrial establishments.

Taking from 60 to 70 tons as the average weight of a train, including the locomotive, the following statistics are given for the laying out of the lines. One in 50 should, if possible, be the steepest gradient allowed; gradients steeper than 1 in 40 are not favourable to a regular and profitable working. With regard to gradients between 1 in 40 and 1 in 50, they should have, if longer than from 1300 to 1600 feet, horizontal stretches before them of at least double the distance. Steeper gradients also, up to 1 in 25, if they do not exceed a corresponding length (1 in 30—650 ft., 1 in 25—330 ft.), can be overcome by the tractive power generated, and without an additional locomotive.

\* *Min. Proc. Inst. C.E.*, vol. cxvi.

Still steeper gradients, up to 1 in 18, can be overcome, if the gradient is not longer than the length of the train. Curves under 650 ft. radius should be avoided in gradients steeper than 1 in 60.

A good solid substructure is very important, both for safety and efficiency, as well as for cost of maintenance. With regard to the permanent way materials, the following statistics are given. The rails should weigh at least 19 lbs. per yard; for this weight a rail  $2\frac{3}{4}$  ins. in height, with a strong head and wide base, is the most favourable. The distance between the sleepers should be from 2 ft.  $1\frac{1}{2}$  in. to 2 ft.  $4\frac{1}{2}$  ins., the breadth of the sleepers from  $5\frac{1}{4}$  ins. to  $6\frac{1}{4}$  ins., and their length should not be under 4 feet. The fish-joint should be strong and durable, either flat or angular fish-plates, with 4 bolts and suspended joints, being used. The most suitable length of the rail is 16 feet.

The locomotives, constructed at the works of Messrs. Krauss & Co., at Munich, have given satisfaction, and combine great flexibility with easy running, and, on account of the low position of the centre of gravity, have proved themselves especially adaptable to the sharpest curves and steepest gradients. The boilers of the locomotives are tested to 300 lbs. per sq. in., the highest steam pressure allowed in practice being 225 lbs. per sq. in. The weight of the locomotive, with coal, water, etc., amounts to 14 tons 14 cwts. The traction efficiency has been found as follows:—

1.	On lines with gradients up to 1 in 100	...	...	108 to 117	tons	
2.	,"	,"	1 in 50	...	59 to 69	"
3.	,"	,"	1 in 40	...	49 to 54	"
4.	,"	,"	1 in 30	...	34 to 39	"
5.	,"	,"	1 in 25	...	27 $\frac{1}{2}$ to 29 $\frac{1}{2}$	"

The consumption of coal per locomotive per hour amounts to from 275 to 440 lbs., and of water from 132 to 198 gallons, according to the train loads, the speed, and the gradients. The locomotives can run with stores of water and coal carried in their own tanks, sufficient for  $2\frac{1}{2}$  hours' consumption, rendering tenders unnecessary.

The average speed attained is  $9\frac{1}{2}$  miles per hour, but on lines specially well laid out, this is increased considerably. The locomotives are fitted with pumps, so that the erection of elevated water-tanks is unnecessary, and water can be drawn from low-lying tanks or natural watercourses.

The waggons are so constructed that the upper frame or box can easily be taken off the light-wheeled under frame, and the under frame or waggon can then be employed for the transport of long timber, girders, etc. The boxes have a carrying capacity of 5 tons, and their cubical contents are 222 cubic feet. The waggons are fitted with central buffers of cylindrical form, well-made axles, without springs, single-flanged wheels, upright spindle brakes, with brake-blocks placed behind the wheels, and journals which can be well lubricated. By these contrivances, the cost of the waggons is increased; but, on the other hand, they ensure easy running, and by that means diminish the train resistance, the consumption of coal, etc. The general average wheel diameter is  $17\frac{1}{2}$  ins., and the wheel-base 2 ft.  $3\frac{1}{2}$  ins.

The question as to whether a single or double-flanged wheel is best for the locomotive was decided in favour of the former.

The possibility and safety of passenger traffic on the 1 ft.  $11\frac{1}{2}$  ins. gauge has been proved by practical experience. The car is constructed after the style of a tramway-car, with longitudinal seating for twenty persons; it rests upon two bogies with springs, and runs throughout lightly and easily.

TABLE L.  
PARTICULARS OF SUNDRY CONTINENTAL LOCAL RAILWAYS.

NAME OF RAILWAY AND COUNTRY.						REMARKS.
Caen to Lanc sur Mer and Dives.	Brussels to Ixelles.	Hannet to Asbach and Beuel.	Hain- berg to Kipsdorf.	Ferdinand- shot to Friedland.	Altensa to Ludenscheid.	<i>Busses to Ixelles.</i> —This is a steam tram-way, worked by steam, electricity, and horse power. The rails laid in streets are 60 lbs. per yard.
France.	Belgium.	Germany.	Germany.	Germany.	Germany.	<i>Hennef to Asbach.</i> —Country mountainous. There are eight stations, with extensive accommodation, and a large number of bridges.
feet	metre	2 0	2 6	2 0	metre	<i>Hainsberg to Kipsdorf.</i> —Earthworks heavy, and bridges numerous. 35-lb. rails are being put down.
feet	miles	23½	23	15	16	<i>Friedland to Friedland.</i> —Works are of a heavy nature. The wheels of the carriages are double flanged, and the sleepers are laid 2 ft. 1 in. apart. Sidings are laid into farm-yards.
Gauge of railway	..					<i>Altena to Ludenscheid.</i> —Earthworks are heavy, including a tunnel 200 yards long.
Length	..					<i>Rates and Fares.</i> —
Weight of rails per lineal yard of rail	..	lbs.	40	30	16	1st. Class 1½d. per mile.
Steepest gradient	..	1 in	25	12	30	3rd. Class ½d.
Sharpest curve	..	feet	99	80	50	Goods per ton 1½d.
Maximum speed	..	miles per hour	12	20	29	Transhipping 2d. per ton.
Cost per mile, including rolling stock	..	£	2153	—	145	<i>Train Service.</i> —Four each way per day, of 1 engine and 15 vehicles (coaches and trucks).
Cost per mile, main- tenance (labour only)	£	25	—	16	—	
Interest on capital	..	per cent.	8	—	9	
				5	—	
				5	—	
				—	12	
				900	3950	

## AUSTRIA.

*On Actual Organization of Local Railways in Austria, and its Projected Amendment.\**

The gradual completion of the system of main lines in Austria, with its branches for strategic purposes, and its light railways (*Nebenbahnen*)† by no means corresponds to the actual needs for new lines of local interest. On all sides in Austria there arise on this point quite justifiable outcries and urgent demands to connect with the main lines, districts so to speak economically abandoned, so as to save them from absolute impoverishment. A country's industrial development in agriculture and forestry is impossible unless that country has railway connection; but districts depending upon such industries can only expect—especially at the commencement of their means of communication's existence—a limited traffic, as a rule; providing a return insufficient to cover the interests on primary capital as has up to the present been the case with the *Nebenbahnen*. It has therefore been recognized—unfortunately a little late—that railways which have only to serve local interests should not be constructed and worked after the same principles, and on the same pattern, as those recognized as advisable for railways of the first or second classes.

Generally speaking, as in the case of important enterprises or financial institutions in a large town, the organization and appointments differ from those applicable in the case of a small town; so, in the same way, the administrative organization of main lines, with their expensive equipments, the complicated procedure in their business, and the great difficulties attaching thereto, are inapplicable to local railways.

In order that these railways, as in the case of tramways, can be advantageously developed, and really benefit, not only those concerned as well as the district itself, but also the Treasury by increasing the general revenue, by developing various industries which may tend to assist in, as it were, feeding the main lines, one must look to the lessening of original cost, to the simplification of working, and to reasonable rates for the carriage of passengers and goods.

If, therefore, districts up to now neglected, from an economical point of view, are to be expected to take part in industries, and to be given means of intercommunication, railways of secondary importance must be left free to choose their own route and gauge, and also their own methods of construction and working, as well as the organization of their service. Briefly, the enterprise must be conducted on commercial lines, and not on bureaucratic ones.

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\* International Railway Congress, London, 1895. Report by Mr. E. A. Ziffer.

† In Germany, *Nebenbahnen* signifies a class of railway with normal gauge on which the permanent way is similar in everything essential to that on main lines, but on which the speed must not exceed 25 miles an hour at any point of the line. These railways are classed as secondary.

In Austria, *Nebenbahnen* means secondary lines which connect districts with main lines. By local lines in Austria are meant the above-mentioned lines (*Nebenbahnen*), as also lines in the third rank (tertiary), which are intended merely to serve local interests, and may be of either normal or narrow gauge, with traction by mechanical means. These local lines have differences not only so far as their construction is concerned, but also in their importance from an economic point of view.

These general observations, which have a close connection with the return to be expected from methods of communication of secondary character, are highly important, and have an intimate connection with the future development and prosperity of local railways.

The necessity for cheap methods of communication, and also the fact that railway construction has practically ceased, caused the Government to build partly at the expense of the State and partly with the help of private persons, a certain number of railways, the construction of which has been carried out in each case by special laws. In the autumn of 1875 these lines were officially christened local lines (*Localbahnen*)—a name which has been kept up to the present, not only for branch lines in the limited sense of the word, but also for all railways of secondary character.

Continuous and reiterated outcries on the part of the population, with a view to obtaining such methods of communication, resulted in causing a law to be passed in 1880, affording advantages and facilities in constructing local railways even without the co-operation of the State. By this law, which was passed on the 25th of May, 1880, the Government was authorized not only to afford all possible facilities as far as concessions, construction, and working of local lines (secondary, district, and others), but also to relax certain regulations for the working of railways especially in connection with rates, time-tables, and speed.

Further, this law permitted those undertaking local lines to be exempt from adhering to the regulations concerning postal working, and also from Government inspection of working; it allowed the roads belonging to the State to be used without payment, on condition that the part used should be kept in repair; for a period of thirty years the companies were exempted from payment of ground taxes, and from duties of all kinds connected with the formation of companies, the issue of shares and bonds, and duties on petitions, agreements, etc.; lastly, the companies were freed from any new tax which the State might levy, during the coming thirty years.

These advantages and facilities, in conjunction with the favourable state of business during 1881 and 1882, had the desired effect, and the expectations founded on the passing of this law, the benefits of which were prolonged from the end of 1882 to the end of 1884, were realized. However, as the result of lines being allowed to be constructed, the returns on which turned out somewhat unfavourably, private capital was from 1883 disinclined to continue these undertakings.

The Government, then, being greatly interested that the construction of railways should not cease completely, came to the aid of these enterprises either directly by advancing money, or indirectly by favouring agreements with the railway companies interested.

Moreover, in March, 1894, the Government submitted to Parliament a new law dealing with facilities and benefits to be afforded to local lines, in order to increase the construction of them.

This law, which was an addition to that of 1880, contained some further regulations justified by a complete examination of the situation in general, and more especially by the experience obtained up to that date. However, as the session of Parliament was too near its termination to discuss this new law, the law of 1880 continued in force up to the 1st of July, 1894.

It was not till June, 1894, that two bills were submitted to Parliament in conformity with the conclusions arrived at by the Railway Commission of 1884.

One of these bills was to apply to the regulations connected with the construction

and working of local railways, while the other dealt with the regulations concerning the construction and working of lines on roads (steam tramways).

The Government intended by these two bills to definitely settle, in a very liberal manner, the regulations for local railways, and, moreover, to decide by Act of Parliament the right to make use of roads not belonging to the State, and also to make a definite distinction between horse tramways and local railways. These latter, then, were ranked as licensed undertakings, while there was left to the local authorities the right to authorize their highways to be used by tramways.

Comparing the provisions of this law with those of that of 1880, it will be seen that the advantages and facilities connected with the construction and working of local railways were extended, in reference to the expenses connected with joining these lines to the State main lines on the one hand, and on the other hand to those resulting from the stations being used and maintained in common, being charged to the State; further, if those concerned in making a local railway cannot obtain the necessary capital, the Government is authorized to assist either by a fixed subsidy, or by taking part in finding the necessary capital; or, lastly, by undertaking at its own expense the working, with the proviso that the district and local authorities take an equal share in the undertaking, and that the State lines shall have the right to make use of the normal-gauge local railways for their own purposes, without on that account losing the right of purchase on the part of the State as stipulated under the Act of Concession.

It was further decided that the issue of bonds is admissible, if the Government shall have determined that the interest due on, and the paying off of, these bonds are assured; finally, the regulations with regard to the employment of the State highways and other public roads were modified, giving further facilities.

Under the above-mentioned law, 132 lines, with a total length of 2247 miles, have been passed for construction between 1880 and the end of 1883.

These 132 lines together represent 22·5 per cent. of the total length of the Austrian railway system, that is to say, on the average, 10 lines a year, with a mileage, roughly speaking, of 173 miles. This figure is not large, taking into consideration the fact that it represents the railways built not merely with a view to local interests. The absolute stagnation in the development of secondary lines was most marked in 1887, and the development did not recover itself till 1892, because private capital absolutely demands some return on outlay.

In order to encourage the undertaking of local railways, the Diets showed their interest in these enterprises, by promising them the co-operation of the State, provinces, local authorities, and other persons.

With this view, the Diet of Styria passed on the 11th of February, 1890, a law the principal provisions of which may be summarized as follows:—

When those interested in the construction of a local railway, acknowledged as of public service for a province, are not able to provide the capital necessary for the construction, the Diet will be responsible for it. It will itself take in hand the rights to construct and work it, or it will find means so that the concessions acquired may be carried out.

For this purpose the province of Styria raised, by means of a loan, a sum of £833,333 as the maximum to be expended on local railways, which sum is kept as a separate account.

This fund can only be made use of for the construction of a local railway, if either the persons benefiting, or the State, or these two together, agree to give as an out-and-out contribution, at least a third of the necessary construction capital, or to

accept shares at their nominal price; and lastly, in case of the receipts falling short, to provide during the whole duration of the concession 4 per cent. interest, as also three-eighths of the amount put aside for the repayment of the capital.

The inspection of the construction and working of these local lines will be carried out by special officers, appointed (under a law of the 11th of February, 1890), to look after the construction and working, apart from the right of inspection by agents of the State provided for by the laws of the Empire.

The working of such lines will, as a rule, be carried out by the Administration of the railways with which they form junctions, in consideration of repayment of actual working expenses, or else the Administration which owns the line will work it itself.

The example set by the province of Styria has suggested to the Diet of Bohemia the advisability of following suit. Accordingly, a law was passed which came into operation on the 17th of December, 1892.

This law, however, varies from that of Styria in one important particular, namely:—

The country will not be responsible for, nor will it undertake the construction of a local line, except under altogether exceptional circumstances. But it is accepted as a principle that the guarantee of interest on the necessary capital shall be at the country's expense.

The law provides for several kinds of subsidies, which may be practically grouped under two heads, as follows:—

Subscription of money to private railway enterprises, and building the railway by the country itself.

The subscription may take the form of guaranteed interest and a sinking fund to pay off the bonds issued by the undertaking, or else as a loan of the country up to 70 per cent. of the cost of construction. Further, the country can co-operate in the undertaking by guaranteeing the preferred shares issued to make up the costs of construction, or by taking preferred shares itself, or ordinary shares at their full price, which practically means a further subscription.

These two methods of subsidizing mean that those benefiting, or the State, or else the two together, must give out and out at least 25 per cent. of the costs of construction, or else accept ordinary shares at their nominal value; or, lastly, if the receipts be insufficient, provide also the interest and the annual sinking fund to the extent of three-eighths of the sum necessary for this purpose.

In the two above-mentioned cases, the Diet should always have the right to decide that the construction of a local line shall be carried out by the administration of the country itself.

The concession for building a line is granted either to the Permanent Commission of the province or to a third party; but, in either case, the subsidies required to be given in a particular case by the State, or by the interested parties, have to be specially applied for. In order to set this law in motion, the Diet has decided to make a loan to an amount not exceeding £833,333 at 4 per cent. The law in question has further found influential support in the agreement made with the Bohemian National Bank. According to this agreement, the Bank grants loans at 4 per cent. for the construction of railways of secondary importance (including industrial railways, local and vicinal lines, electric lines, and steam tramways).\*

\* The circular of the Bohemian National Bank on the subject of railway loans is to be found in the second part of the publication of the Association for the Development of Light Railways and Tramways, 1893.

Galicia, in following the same order of ideas as Styria and Bohemia, as far as the encouragement and development of light lines are concerned, passed on the 17th July, 1893, a law which differed in slight measure from those in force in the two latter countries. It was based on the report of a Commission composed of a number of persons specially interested, and technical experts. The Galician Diet took up the position that the construction of light railways ought to be left to private enterprise, and that assistance should only be given after a minute examination of any project. With this object, a provincial railway office and railway council was specially established, with the mission to examine all the projects, to supervise the carrying out of the works, and to take charge of the whole business in reference to light railways in the country. The Diet decided to provide, in the provincial budget, for a period of 30 years,\* commencing with 1894, a sum of £25,000, to be used in subsidizing light railways. The Galician National Bank promised its assistance towards the creation of a special loan fund, from which loans for the construction of such railways could be granted.

These loans, which are not to exceed a total of £1,250,000, will be in the form of railway bonds issued by the railway with a provincial guarantee. Advances will be made by the Bank :—

(a.) To the State and to the provinces, in return for exchequer bills, so as to form a capital for the new lines, and to aid in establishing construction companies by taking their preference shares.

(b.) To private railway companies either secured by a mortgaged charge on their lines, or by a pledge of their bonds.

No loan of this kind can, as a general rule, be made by the Bank, except with the consent of the Diet, the only exception being in the case of railways whose net revenue is guaranteed by the State or by the province.†

It must be confessed that these laws are not likely to do very much. At the same time, it is worth notice that the discussions in the other Diets on the subject of light railways, and the decisions that have been there taken, are distinct evidence that the population everywhere is arriving at the conviction, that the exchange of products between the different provinces and the monarchy has an equally great importance for the agricultural and industrial development of the nation, and for the increase of its prosperity, as the development of export and transit traffic.

For these reasons, the Diets have appreciated the absolute necessity of establishing the largest possible number of light railways affording connection with the existing main lines.‡ The Styrian Permanent Commission has obtained, on the footing of the above-mentioned law, concessions for the following lines :—

	Length in miles.
1. Cilli to Wöllan (normal gauge), opened Dec. 28, 1891 ...	25
2. Pöltschach to Gonobitz (gauge 29·92 ins.), opened Dec. 19, 1893	9½
3. Stainz to Wieseldorf (gauge 29·92 ins.), opened Nov. 27, 1892	7
4. Kapfenberg to Seebach (gauge 29·92 ins.), opened Dec. 9, 1893	14½
5. Murthalbahn (gauge 29·92 ins.), opened August, 1894 ...	47½
Total ...	103

\* This period was extended to 75 years by the Diet, in the session of 1894.

† The regulations as to these loans are to be found in the second part of the publication of the Association of Light Railways and Tramways for 1894.

‡ Vide paper on "The Organization of Local Railways," 3rd No. of the publication of the Association of Light Railways and Tramways. Vienna, 1893.

Projected lines expected to be shortly carried out:—

							Length in miles.
1. Sauerbrunnbahn	...	...	...	...	...	...	20 $\frac{3}{4}$
2. Unterdrauburg to Wöllan	...	...	...	...	...	...	23 $\frac{1}{2}$
3. Zeltweg to Wolfsberg	...	...	...	...	...	...	31
4. Neuberg to Mariazell	...	...	...	...	...	...	24
5. Hartberg to Aspang	...	...	...	...	...	...	32
Total	...	...	...	...	...	...	131 $\frac{1}{4}$

The Bohemian Permanent Commission has submitted to the Diet, which has just been made at Prague, a long report in favour of the construction of 7 light railways, requiring an expenditure of £1,250,000. The support to be given in this case would lie partly in a subsidy to the amount of £50,000, invested in ordinary shares, and partly in a guarantee of 4 per cent., and a sinking fund on the bonds and preference shares to be issued by the railways, to the extent and under the conditions, laid down by the provincial law of December 17, 1892. The above-mentioned Commission is still considering 17 other light railways projects, for the execution of which it purposed to ask the necessary assistance. Besides these five, others have been referred to its consideration, with a request that it will support them.

In the report above-mentioned, the following curious fact deserves special notice:—

Two proposals for the construction of one of the lines, that, namely, from Neuhaus to Neubistritz, a distance of 12 miles; the one was a normal gauge, and the other a 29.92 ins. gauge. The experts of the Commission to whom these proposals were submitted for examination reported, that the normal-gauge line would cost £125,000, whereas the expense would only be £95,000, or a difference of £30,000, or 24 per cent., *if the narrow gauge were adopted*. This was accordingly done.

In the same report, the Bohemian Permanent Commission suggests the establishment of a railway council of 14 members, to advise it on all light railway matters, but it leaves the organization of this council for future consideration.

Finally, the Galician Diet has decided to grant, on account partly of the province, and partly of individuals affected, a subsidy of £83,333, in return for ordinary shares taken at their par value to each of the following undertaking:—Podolen Light Railway, with a total length of 120 miles, and a capital of £833,333; a light line from Halicz to Ostrow, with a length of 81 miles, and a capital of £841,666. The remaining £1,500,000 capital of these two undertakings will be guaranteed by the State, and the Companies to be formed will issue bonds and shares to be paid off in 75 years.

The first impulse in the direction of narrow gauge, especially 29.92 ins. lines, comes from the extraordinarily satisfactory results obtained in the construction and working of the Imperial and Royal Bosna line, which, together with the State lines in Bosnia and Herzegovina, forms a narrow-gauge system 379 miles in length, the longest in Europe except the Norwegian.

The following statistics show that the employment of *ordinary gauge* in Bosnia and Herzegovina would have been *absolutely inconsistent* with the present development of their lines.

The capital spent on them up to 1891 amounts on the average to £7,065 per mile, and even this is considerably larger than it need have been, owing to the fact that these lines were originally only temporary, and had to be made permanent,

a state of affairs that ordinarily does not arise. The adoption of normal gauge, according to the estimates given, would have required, in consequence of the difficulty of the country, an average expenditure of £12,662 per mile. The following comparison between the density of traffic on the railways in question and that on the Austro-Hungarian railways of normal gauge is entirely to the *advantage of the narrow gauge*, as this table shows :—

Traffic.	Austro-Hungarian standard-gauge railways.	Boana Railways (length, 166 miles). 2 ft. 6 ins. gauge.	State Railways of Bosnia and Herzegovina. 2 ft. 6 ins. gauge.	
			Doboj and Simin Han (length, 41 miles).	Sarajevo and Metkovic (length, 110 miles).
Passengers ..	172,617	73,271	33,521	30,707
Tons of goods ..	396,139	65,411	63,870	16,272
<i>Mileage</i> receipts ..	£1,890	£580	£324	£235

Although the gross receipts from the narrow-gauge lines in question are relatively small—being only from 12 to 30 per cent. of that of the railways of normal gauge—it is none the less true that the capital of the light lines pays interest at the rate of 3 per cent.

The result of the working for the year 1892 is as follows :—

Name of the line.	Mileage.	Passengers	Goods tonnage	Receipts	Expenses
		carried per mile.		per mile.	
Imperial and Royal Railway of Bosnia	166	49,781	48,062	£ 531	£ 286
State Railway of Bosnia and Herzegovina, Doboj—Simin Han ..	41	21,862	34,973	255	256

It should therefore be stated that the carrying capacity of these narrow-gauge lines, though it is already very considerable, could be greatly increased by adding to their rolling stock, enlarging and improving their stations, and increasing the number of trains. Thus, if there were twelve trains each way daily all over the Bosnia line, it would be able to carry 512,000 tons per mile per annum, and yet the *extreme limit of the capacity of the line would not be reached*.

The Klose locomotives adopted for these new lines possess the same tractive force as normal-gauge engines.

This type of locomotive has 12 wheels, 10 of them coupled. The first and the last pair of coupled wheels have a radial motion, the three middle pairs are fixed; the midmost of these three are without flanges, whereas the flanges of the pairs on either side of it are extra thin. The total length of the locomotive is 39 ft. 4 $\frac{1}{2}$  ins., and the wheel-base 26 ft. 10 $\frac{1}{4}$  ins. The weight empty is 32 tons, in working order 45 tons; the weight available for traction about 40·5 tons. There is room for 222 cubic feet of water, and 127 cubic feet of coal. These engines are capable

of developing some 350 to 400 horse power. The carriages have intercommunication throughout. There are first-class on bogies, weighing 13 tons, with *coupé-lit* accommodation. The ordinary first- and second-class carriages weigh 17.7 tons. There are also second class, seating 30 passengers, weighing 30 tons. The wheel base is 31 ft. 2 ins. It is true that the dead weight is considerable, but, on the other hand, the carriages are very comfortable, and very well fitted up.

The length over all is 41 ft. 4 $\frac{1}{2}$  ins., the width 7 ft. 10 $\frac{3}{4}$  ins. There is a corridor down the middle, a w.c., seat for the conductor, etc. There are also sleeping carriages, which meet all the requirements of comfort, both in fittings and arrangement, and are comparable in every respect with carriages on normal-gauge lines. For local traffic there are second- and third-class bogie carriages, weighing 9.3 tons, also with a corridor down the middle, but with no w.c. There are also standing places on the front platform; they carry 48 passengers, and their wheel-base is 23 ft. 11 $\frac{1}{4}$  ins. There are covered goods waggons on bogies, capable of carrying 15 tons, and weighing, brakes included, 9.6 tons, or without the brakes, 8.6 tons. Their total length is 38 ft. The length inside the body of waggons, without brakes, is 35 ft. 7 $\frac{1}{2}$  ins., and of those with brakes, 33 ft. 7 $\frac{3}{4}$  ins. The internal height is 7 ft. 5 $\frac{3}{4}$  ins., and the width 6 ft. 11 ins. The total floor space is equal to 247 $\frac{1}{2}$  square feet, and there is room for 6 horses in ordinary waggons. The open waggons also, capable of carrying 15 tons, are of the same length, but their width is 7 ft. 1 $\frac{1}{4}$  ins. The height of their sides is 3 ft. 8 $\frac{3}{4}$  ins.; their dead weight is 7.3 tons, and their wheel-base measures 31 ft. 1 in.

The trains on the Bosnia line run at a speed of 22 miles an hour, and the rolling stock of the Bosnia and Herzegovina Railways run without difficulty at this speed round 3-chain curves.

The local lines of Styria on the 29.92 ins. gauge bear witness to the *economy* in capital expenditure that can be effected by narrow as compared with normal gauge. Thus, whereas the light line of normal gauge from Cilli to Wöllan, 25 miles long, cost £9000 per mile, the cost of building and supplying rolling stock on the above-mentioned lines on the 29.92 ins. gauge, have been as follows:—

For the lines from Stainz to Wieseldorf and the Pöltschach to Gonobitz, with a total length of 16 $\frac{1}{2}$  miles, £3144 per mile.

For the very hilly and difficult line from Kapfenberg to Seebach, with a length of 14 $\frac{1}{2}$  miles, £4265 per mile.

For the Murthalbahn line, at present under construction, with a length of 46 $\frac{1}{2}$  miles, about £4000 per mile.

The provisional accounts of the cost of working the normal gauge Cilli-Wöllan line for 1893 are also an argument in favour of narrow gauge, where, thanks to the simplification of the traffic arrangements, there is a marked economy in expenses. As a proof, we see that the cost of working the Cilli-Wöllan line amounted to £272 per mile; in other words, to 57 $\frac{1}{4}$  per cent. of the receipts; whereas the expenses of working the narrow-gauge lines Preding-Wieseldorf-Stainz were £72 per mile, or, in other words, say 15 $\frac{1}{2}$ d. per train mile, or 55.7 per cent. of the receipts.

The expenses of the Pöltschach-Gonobitz were £74 per mile; in other words, say 1s. per train mile; that is, 65.1 per cent. of the receipts.

These results are sufficient to show the advantages of the organization adopted on the lines in question. In addition to the Styrian lines on the 29.92 ins. gauge mentioned above, there are in Austria the following additional examples of narrow-gauge light lines:—

Name of Company.	Mileage.	Gauge.	Milesge cost of con- struction.	Working receipts.	Working expenses.	Percentage of expenses to receipts.	Date of open- ing of lines.
				1892, per mile.			
Localbahn Inns- bruck - Hall (Tyrol) ..	7½	39.37	5489	736	422	57.4	1891
Steyerthalbahn Gesellschaft	30	29.92	3360	291	243	84.1	1890
Salzkammergut Localbahn-Actien Gesellschaft	39	29.92	3184	313	178	57.4	1891
Localbahn Mori- Arco-Riva a/g ..	15½	29.92	6704	453	253	55.7	1891

These figures must not be taken as unalterable, for the railways have only been a short time open, and their traffic is but just beginning to develop.

The Ybbsthalbahn Railway must also be mentioned here. Its length is to be 33½ miles, and its gauge 29.92 ins. Parliament decided upon the construction of this line last December. It branches from Waidhofen-s/Ybbs, a State railway station, and terminates at Gamming, the station of a local standard-gauge railway, which runs from Pöchlarn to Gamming, and this also belongs to the State.

The projected line in question will *join two standard-gauge* lines; however, it will be constructed with reduced gauge for economical reasons. It is even being discussed whether it would not be advantageous to alter the above-mentioned line from Pöchlarn to Gamming to a 29.92 ins. gauge, so as to economize working.

Lines intended to, as it were, feed the main line, have to be constructed and worked at the least possible cost, for most of the districts in Austria are of a mountainous character, and but limited traffic is expected on them.

The favourable results obtained in the construction and working of the narrow-gauge lines in Bosnia and Herzegovina have caused an extension of the construction of these lines, under certain circumstances recognized as being advantageous.

The fact that more economical methods of construction and working have been sought is owing to the provisions of the law at present in force, on the construction and working of local railways, although this law does not yet supply sufficient facilities and advantages to encourage the promoters of such enterprises.

This view must have been that of the Minister of Commerce, when he made enquiries of experts and others interested in the matter, who had been engaged in developing local railways, and gathering data on them.

The inquiry was to elicit suggestions as to what new facilities and advantages in the matter of preliminary investigations, and in the construction and working of such railways and tramways, might be afforded by the legislature. Great importance is attached to these concessions by those interested in the matter, who hope that they may be sanctioned by the new law, as they, in some special cases, at present lie within the powers of Government, with the proviso, however, that the principles of the regulations *ad hoc* should be maintained.

The report of the Union of Austrian Local Railways (*Verband der österreichischen*

*Localbahnen*) starts with the idea that by local railways of secondary order should be understood both lines of standard gauge, and those of narrow gauge intended for the movement of both passengers and goods, serving chiefly the local traffic of one or more neighbouring districts, running at a limited speed, and the traffic on which is of secondary importance in comparison with that of the main lines. It is a matter of indifference in this case whether these railways are built on their own ground or whether they borrow all or part of the existing roads. The motor power has no appreciable influence on whether the railway should come under the category of local or tertiary lines.

On the other hand, the railways which are only partially used for public traffic, that is to say, for carrying passengers and goods, or those which have been constructed to carry certain traffic exclusively, or lastly, those employed only for private enterprise, should be ranked in the category of railways of very inferior order, *i.e.* "tertiary lines."

It is quite recognized that these latter require to be dealt with altogether differently from local railways, so there will have to be introduced into the new law, under a separate heading, a special regulation for tertiary railways.

All the facilities and advantages granted for the concession, construction, and working of these tertiary railways should be also included under this heading, facilities which, taking into consideration the inferior quality of these lines, should be even more extensive than those proposed for local railways.

Every advantage should be afforded directly to the local railways in the matter of duties, stamp duties, and other taxes, for this would encourage the making of local and other lines, if each knew beforehand on what basis estimates might without hesitation be made.

The above-mentioned Union suggests still another series of concessions, of which some should be permanent in every case, and others temporary; that is to say, as long as the returns of a railway did not pay 5 per cent. interest as well as provide a sinking fund to pay off the original capital.

The permanent concessions suggested are as follows:—

Exemption from the cost of works in connection with alterations and extensions at junctions.

Exemption from the cost of equipments and from forced labour necessary from a military point of view, or from general State interests.

Exemption from the expenses entailed by State inspection, and by payment of officials of the Imperial inspection staff of the Austrian Railways.

Carriage, at out-of-pocket cost, of earth for works, materials, equipment, etc., necessary for the formation and working of the railway.

Loan of the rolling stock at a price to be fixed according to the amount of use made of it.

Free use of junction stations and exemption from expenses in connection with the management of these stations.

Free use of the State telegraph and telephone.

The right to grant to the Government the working of local railways at a fixed price, or any other method of payment that may be agreed upon as far as possible without burden to the local railways.

Permission for the company to choose normal gauge or narrow gauge of 39·27 ins., 29·92 ins., 23·62 ins. Permission to adopt either the *rack* or ordinary method of working, and to select the weight of the rail to be used, rolling stock, etc.

The temporary advantages to be afforded to local railways should be annual

subsidies given on the basis of the sum saved by the construction of these railways in mail carriage, in keeping up the State roads, in the repair of banks of streams and rivers, in the management of State property, mines and factories, and lastly, a rebate on the increase of traffic and receipts of the main line to which the local line serves as a feeder.

When the State uses these local lines, it should not be done in a competitive spirit.

The right of the State to purchase local lines should not be permitted till after a period of 20 years, counting from the day of the opening of the line, for the actual provisions with reference to purchase are really somewhat discouraging for those who request local railway concession.

As far as using the State roads are concerned, special provisions affording such facilities should be allowed, depending upon the actual state of affairs. Thus, the maximum demanded of local railways should be to re-establish the *statu quo ante* of the roads, and in cases where the road will probably become less frequented in consequence of the local railway being constructed, the reduction in width of the road should be permitted, that part of it which the ordinary cart traffic can do without being granted gratuitously to the enterprise.

Moreover, the part occupied by the rails should be as far as possible separated from the rest of the road surface, and the keeping in repair of the road by the enterprise should be limited to the part actually occupied; the same rule should apply to keeping it clean in so far as that is necessary for maintaining a good working service.

Besides these suggestions, the Union of Austrian Local Railways has expressed definite wishes, of which some are of a general character, and others quite special.

Those of a general character are as follows:—The institution of a special office for local railways, tramways, and tertiary railways at the Ministry; appreciable modification, and, later on, total abandonment of the practice of enforcing the rules prescribed for main lines in the case of local railways; exemption, so far as may be possible, for these lines from the necessity of providing periodic and other reports to the authorities whose business it is to act as State inspectors, and especially in connection with statistical returns.

The wishes of a special character comprise: Further freedom from ordinary taxes as well as from district rates; exemption from expenses in connection with costly apparatus to ensure safety at level crossings; regulations in connection with using roads to ensure the regular train service, and to safeguard the road against contingencies of destruction; regulations about putting up warnings and keeping up fences on existing roads, and those to be made in the future.

Finally, all the advantages provided by the new law should apply to local railways already in existence, without affecting any still more extensive benefits which may have been afforded to them at the time of concession.

We are of opinion that if it be desired to encourage to the greatest possible extent the development of local railways, it would be necessary to introduce into the new law concessions tending to still further stimulate private industry to build them.

We have not a moment's doubt that *the future belongs to lines of inferior character*, and that they will prove as advantageous to the initiators as to the districts served, if they are only considered as traffic enterprises, to be carried out on economical principles, in a simple but careful manner, similarly to other commercial business, and without costly and complicated mechanism.

The various people interested in the matter will undoubtedly recognize then that these means of communication have both great value from an economical, as well as from a political point of view, but that they will not be carried out unless efficient assistance and helpful co-operation be brought to bear upon them from all sides.

#### LIGHT RAILWAYS IN DIFFERENT PARTS OF THE WORLD.

##### **Anglo-Chilian Nitrate Railway—Tocopilla to Toco.\***

*3 ft. 6 ins. gauge; 40-lb. rails; 55 miles long.*

The gradients are 1 in 25, with minimum radius of curves of 181 ft. There is a continuous gradient of 1 in 25 for 17 miles, except where sharp curves necessitate a flatter one of 1 in 30. The line rises 4902 ft. above sea level by several reversing stations, and in some instances the railway describes complete circles. The line is constructed through a very rough country, and there is a short tunnel on it. This part of the country being rainless, it was not necessary to provide many culverts for passing surface water. Hard rock was found in many of the cuttings.

The cuttings are 10 ft. wide, the banks 9 ft.

The rails weigh 40 lbs. per lineal yard, spiked to native oak sleepers 7 ft. and 9 ft.  $\times$  8 ins.  $\times$  4½ ins., and laid 2420 to the mile. Where the curves are very numerous, the rails are laid with alternating joints, to save labour and expense. Clip tie-rods, four to each rail, are fixed on all curves of less than 300 ft. radius, as it was not possible to keep the line in gauge without them. The weight of the permanent way, including sleepers, is 170·45 lbs. per lineal yard.

The cost of maintenance is £77 per mile per annum.

The rolling stock is of special type to suit the heavy gradients and sharp curves. The locomotives are eight-wheel-coupled tank engines, with leading and trailing bogies, and outside cylinders 17 ins. diameter, and 21 ins. stroke, with steam pressure 160 lbs. per sq. in., and working weight of 52 tons. Taking the mean pressure of steam at 120 lbs., the tractive force is 18,916 lbs.

These engines draw five loaded waggons, or a gross load of 85 tons, up 17½ miles of 1 in 25; and for 9 miles up 1 in 36, twelve loaded waggons, or 200 tons gross. The rigid wheel-base is 6 ft. 8 ins.

\* *Min. Proc. Inst. C.E.*, vol. cxv.

The waggons are low-sided platform, double-bogie type, 22 ft. long, 6 ft. 8 ins. wide, with sides 9 ins. high, and carrying 15. tons. Several of the waggons have sides 30 ins. high, for carrying coal. The rolling stock is fitted with automatic vacuum brakes. Without these brakes, the running of loaded trains would be very dangerous, for besides the heavy gradients, the curves are so numerous that a train is often on two, and sometimes on three, curves at one time.

The cost of the line can only be given approximately, on account of the variation in exchange, as under—

			per mile.
	£	£	
Forming the line ... ... ... ...	76,700	=	1395
Permanent way materials ... ... ...	35,307	=	642
Laying the permanent way ... ... ...	25,300	=	460
Stations and buildings ... ... ...	20,000	=	364
Rolling stock, including erection ... ... ...	29,320	=	531
Machine tools for workshops, etc. ... ... ...	9,600	=	175
Telegraph wire and instruments ... ... ...	600	=	11
	<hr/> £196,827	<hr/> £3578	

#### Little Railway for Special Temporary Work.\*

2-ft. gauge.

This line, 3 miles long, was laid for the purpose of clearing a pine forest in East Pomerania; economy in construction and working was a primary consideration. It was estimated that the line would only be used for  $2\frac{1}{2}$  years, and at the end of that time would have to be taken up. Old rails were hired from the railway company, laid on wooden sleepers, and the line was worked by horse power. There was a wooden viaduct on the line 200 yards long, consisting of 45 spans, each 13 ft.  $1\frac{1}{2}$  in. The maximum gradient was 1 in 40, and the minimum curve  $3\frac{1}{2}$  chains radius.

The waggons weigh  $2\frac{1}{2}$  cwts. each, two are placed under a log, which rests on cross-bearers pivoted in the centre. Logs 65 ft. long have been carried round curves 80 ft. radius out of sidings.

Six journeys each way per day are made from the railway station to the forest; each train comprises two sets of waggons, and the daily

\* *Min. Proc. Inst. C.E.*

freight is 48 tons. The staff employed is twelve men and seven horses.

4 men and 4 horses cart to loading-place.

3 men and 3 horses work the train.

5 men unloading at the railway station.

The cost of the undertaking is given as under—

*Cost of Construction.*

		£	s.	d.
Land	...	84	0	0
Earthwork	...	72	10	0
Permanent way, including siding	...	231	10	0
Viaduct	...	100	0	0
Loading dock	...	35	0	0
Ten sets of waggons	...	97	10	0
Signalling and telegraph	...	25	0	0
Engineering and miscellaneous charges	...	63	10	0
		<hr/>	<hr/>	<hr/>
		£640	0	0

or about £224 per mile, without rails.

Deduct estimated value of waggons and materials at end				
of $2\frac{1}{2}$ years	...	150	0	0
		<hr/>	<hr/>	<hr/>
		490	0	0
Add cost of taking up line	...	35	0	0
		<hr/>	<hr/>	<hr/>
<i>Net cost</i>	£525	0	0	

*Total Expenditure on Works.*

Net construction as above	...	525	0	0
Toll for use of main line $2\frac{1}{2}$ years, at £35	...	87	10	0
Toll for use of rails	£57 10s.	143	15	0
Railway company's service, inspection and maintenance				
of works at station, £30	...	75	0	0
		<hr/>	<hr/>	<hr/>
Total	...	831	5	0

or per load of 10 tons = 13 cubic yards	...	8	4	
Add forest tax	...			3
Cost of transport to main-line trucks	...			9 6
		<hr/>	<hr/>	<hr/>
		18	1	

= 1s. 9*3*d. per ton, or 1s. 3*1*d. per cubic yard.

By the ordinary roads, this cost would have been 50 per cent. higher, and the rate of clearance much slower. The line was constructed in six weeks.

**Chinipas Mineral Railway, North-West Mexico.\***

*Gauge, 2 ft. 6 ins.; rails, 25 and 35 lbs. per yard.*

The greater part of this line consists of a succession of sharp curves, with short intervening straight lengths. The minimum radius is 115 ft., used on two curves only; the most common radius is 127 ft. The maximum gradient is 1 in 25, compensated on curves according to their radii.

The bridges are of masonry piers, with superstructures of timber trusses, spaced 7 ft. apart, and braced together vertically and horizontally, both at the top and bottom. The trusses are framed in bays of 13 ft. each, with wrought-iron verticals in tension, adjustable by screws. The depth between the centres of the top and bottom booms is 13 ft. on a span of 52 ft., and 14½ ft. on a span of 65 ft.

The line is a succession of short, deep cuttings and banks, supported by dry stone retaining walls, with occasional tunnels, bridges, and culverts. All the culverts are built of dry stone. The largest are double 4 ft. openings, with the upper courses of the side walls sailing over, and the openings spanned by the largest stones available.

The rails are of steel, 35 lbs. and 25 lbs. to the yard, the latter being light for the traffic. The sleepers were mostly steel, 3 ft. 6 ins. × 6½ ins. ×  $\frac{5}{16}$  in. thick for the 35-lb. rails, and weighing 33 lbs. each, and  $\frac{1}{4}$  in. thick for the 25-lb. rails and weighing 26 lbs. each, including fastenings. The sleepers were short, and lacked bearing surface outside the rail, in consequence of which the road proved expensive to maintain. For the sharp curves and heavy gradients, wooden sleepers found in the district were used of 4 ft. 3 ins. × 6 ins. × 4½ ins. scantling.

The cost of the railway was considerably enhanced by the difficulties of transport. All the materials had to be carried on mules over very rough tracks, and in some cases on men's shoulders. The cost of transport from the coast to Chinipas, 150 miles, including landing charges, storage, agency, etc., was \$75 (Mexican) per ton (2000 lbs.) for the rails and rolling stock, \$60 for the sleepers, and \$56 for the remainder of the material and stores.

\* *Min. Proc. Inst. C.E.*, vol. cxiii.

The rolling stock consisted of two locomotives, each weighing 18 tons in working order, 9 ins. cylinder, 14 ins. stroke, six wheels coupled 2 ft. 6 ins. diameter. They were subsequently altered to 4 wheels coupled, as the wheel-base (9 ft. 6 ins.) was too long for the original curves of 95 ft. There were 25 waggons, entirely of steel, with a wheel-base of 6 ft., and wheels 1 ft. 6 ins. diameter. They were hopper shaped, with bottom doors, to discharge between the rails, carrying  $4\frac{1}{2}$  tons, and weighing  $1\frac{1}{2}$  tons.

The cost of the railway was approximately—

		per mile. £
Materials and stores from England, including freight	...	1379
"      ", other than above	...	870
Transport from the coast to Chinipas	...	1136
Wages and local transport	...	4012
General charges (preliminary, survey, superintendence, etc.)	...	650
 Total	...	<u>£8047</u>

Wages paid in the district—

		Mexican \$	Mexican \$
Unskilled labourers	...	0·75 to 1·00	per day.
Masons	...	1·25	„ 2·50
Foremen	...	3·00	„ 4·00
Quarrymen	...	1·00	„ 1·50
Carpenters	...	2·50	„ 3·00
Tunnels, $4\frac{1}{2}$ cubic yards per lineal foot (13 ft. $\times$ $11\frac{1}{2}$ ft.)	...	15·00	„ 22·00 per lineal foot.
Excavation	...	0·07	per cubic yard.
Rock (not requiring blasting)	...	0·50	„ „
Hardest rock (including explosives)	...	1·25	„ „
Rubble masonry (all cost for labour except mortar mixing)	...	2·50	„ „
Bridge abutments and high walling	...	3·75 to 4·75	„ „
Lofty piers	...	8·50	„ „

#### Developing Railway in Argentina.\*

Gauge, 3 ft.  $3\frac{3}{8}$  ins.; rails,  $32\frac{1}{4}$  lbs. per yard.

The railway is 40 miles long, with 17 miles of branch lines in addition, making a length of 57 miles in all.

The line was constructed for developing the Gran Chaco in the Argentine Republic, containing an area of 42 square leagues. The

\* *Min. Proc. Inst. C.E.*, cxviii.

country is much subjected to floods, and a number of bridges and culverts were necessary. Rough-log trestle bridges were employed for crossing rivers, the timber being obtained in the forests adjoining the line of railway for these and for the sleepers.

The rails are of steel,  $32\frac{1}{4}$  lbs. per yard. The sleepers of hard-wood 6 ft. 6 ins.  $\times$  8 ins.  $\times$  4 ins., spaced 2 ft. 8 ins. apart, centre to centre, and laid in 10 ins. of soft stone ballast.

The maximum gradient is 1 in 80, and the minimum radius of curve 400 ft.

The embankments were protected by fascines against floods, or planted with lagoon grass and long-rooted shrubs. Nine bridges were built on the line, mostly of wood, or with iron girders on wood piling, and sixty-six culverts, all constructed of hardwood.

To protect the bridges from large masses of "camallotes," carried down by floods, an apparatus for loosening them was fixed in the river. This consisted of three sets of floating "spreaders," formed of three long balks, their ends being linked together with chains, and worked from the shore by winches.

Narrow-gauge lines of 1 ft. 8 ins. gauge were used in the plantations, woods, mills, and brickworks, as feeders to the main lines, and for local transport of materials. The total length laid was about 42 miles; the rails were 14 lbs. per yard, spiked to hardwood sleepers 3 ft. 3 ins.  $\times$  6 ins.  $\times$  4 ins. The sharpest curve was 33 ft. radius, and the maximum gradient 1 in 60.

The rolling stock consisted of—

4 six-wheel-coupled locomotives, weighing each 20 tons full.					
4 four-wheel     ,     ,     ,     ,     12     ,					
5 small Decauville     ,     ,     ,     ,     4     ,					
50 bogie truck waggons.					
40 two-axled covered waggons.					
40     ,     low-sided waggons.					
42     ,     flat waggons.					
6 brake vans, two-axled.					
6 goods vans.					
8 second-class carriages.					
5 first-class     ,					

The platforms and bodies of the rolling stock, with the exception of the carriages, brakes, and goods vans, were of native wood sawn in the colony.

The following are the details of the locomotives:—

	6-wheel coupled.	4-wheel coupled.	Decauville.
Diameter of cylinder ..	13 ins.	10 ins.	5 ins.
Length of stroke ..	20 ins.	16 ins.	7 ins.
Wheel-base ..	12 ft. 9 ins.	6 ft. 4 ins.	3 ft. 3 ins.
Diameter of wheels ..	3 ft. 0 ins.	2 ft. 6 ins.	1 ft. 6 ins.
Working pressure ..	120 lbs.	110 lbs.	100 lbs.
Tank capacity ..	800 gallons.	500 gallons.	500 gallons. in engine and tender
Fuel .. ..	40 cub. ft.	25 cub. ft.	30 cub. ft. in engine and tender
Weight of engine loaded	20 tons	12 $\frac{4}{5}$ tons	4 $\frac{1}{5}$ tons
Feed .. .. ..	2 injectors and pump	1 injector and pump	1 injector and pump

The fuel used was wood having a calorific power of about 50 per cent. of coal.

#### CANADIAN NARROW-GAUGE RAILWAYS.\*

In introducing railways into the back country of Canada, it was found that £3000 per mile could be raised from the resources of the country, and consequently it was of great importance that means of communication, costing no more than this sum per mile, should be introduced. The result was the construction of railways on the 3 ft. 6 ins. gauge, with 40-lb. rails. The Toronto, Grey, and Bruce, and the Toronto and Nipissing, were thus projected to open up the country. The ruling gradient was 1 in 60, with a minimum curve of 462 ft. radius.

The structures on both railways, station buildings, bridges, culverts, cattle guards, etc., are of timber, and both are fenced their entire length.

The permanent way consisted of iron rails, 40 lbs. per yard, spiked to wooden sleepers. The sleepers, spaced 2 ft. 6 ins. apart, are 7 ft. 6 ins.  $\times$  8 ins.  $\times$  5 ins., laid on ballast 12 ins. deep.

The locomotives were as follows:—

1. Engines 16 tons, which have been found too light for the traffic.
2. Engines 21 tons, six wheels coupled, running 122 miles daily,

\* *Min. Proc. Inst. C.E.*, vol. xlvi.

with a passenger train weighing 60 tons, and carrying 100 passengers, at a speed of 16 miles an hour, and burning 1 ton of coal.

The passenger carriages were originally 30 ft. long, and 8 ft. 6 ins. wide (extreme), but now they are 43 ft.  $\times$  8 ft. 8 ins., and run more steadily. The waggon stock was 15 ft. and 18 ft. long  $\times$  8 ft. wide, on four wheels 24 ins. diameter; but longer stock is now used.

The Northern Railway of Canada, 5 ft. 6 ins. gauge, runs through the territory between these two railways, through somewhat similar country, and has a traffic similar in character; and it may be interesting to compare the working of the two gauges.

	Toronto, Grey, and Bruce. 3 ft. 6 ins.	Toronto and Nipissing. 3 ft. 6 ins.	Northern Railway of Canada. 5 ft. 6 ins.
Total earnings .. .. ..	£74,467	£41,447	£148,919
Total working expenses .. .. ..	£46,685	£24,093	£94,792
Per cent. of working expenses .. .. ..	62·9	58·1	63·6
Miles open for traffic .. .. ..	191	87	165
Earnings per mile of railway .. .. ..	£389	476	902
Train miles per mile .. .. ..	2087	2357	3889
Earnings per train mile .. .. ..	3s. 10d.	4s. 2d.	4s. 5d.
Working expenses do. .. .. ..	2s. 6d.	2s. 6d.	3s. 1d.
Net earnings do. .. .. ..	1s. 4d.	1s. 8d.	1s. 4d.
Cost per mile of railway .. .. ..	£4355	£3678	£9568

Comparing the above figures, it will be found that—

	£
Broad-gauge railways, average cost per mile ... ..	7987
"      net income ... ..	249
"      = 3 per cent. on cost.	
Narrow-gauge railways, average cost per mile ... ..	4016
"      net income ... ..	162
"      = 4 per cent. on cost.	
Working expenses per train per mile, broad gauge, 4s. 5d.	
"                  "      narrow "  4s. 0d.	

These facts afford a favourable comparison for the narrow-gauge railways, which pass through a country only recently opened up to railway facilities, whilst the broad gauge has been in operation many years.

During the ten years in which these railways had been working, from 1869 to 1879 (the colonies of Grey and Bruce were without railway accommodation in 1869, and Wellington and Simcoe were

only partially accommodated in that year), the increase of the value of assessments in real estate was as under—

								Increase per cent.
County of Grey	...	...	...	...	...	...	...	17
„ Bruce	...	...	...	...	...	...	...	210
„ Simcoe	...	...	...	...	...	...	...	45
„ Wellington, including city of Guelph							...	258
City of Toronto	...	...	...	...	...	...	...	115
„ Hamilton	...	...	...	...	...	...	...	124
„ London	...	...	...	...	...	...	...	70

#### **Antofagasta and Bolivia Railway.**

*Gauge, 2 ft. 6 ins.; rails, 36 lbs. per yard.*

This line is the most striking example of a railway attaining to a great height by means of steep gradients and tunnelling. It is 574 miles long, and reaches a height of 13,000 feet.

The object of the line is to open up for the southern portion of the Bolivian table-land, a rapid and economical route to the Pacific, and to develop the mineral wealth of the Atacama desert.

The gauge of the railway is 2 ft. 6 ins., the rails are of steel, 36 lbs. per yard, the sleepers are of Chilian wood (*roble*). The gradients do not exceed 1 in 32, and, considering the nature of the railway, the curves are of good radius.

The passenger carriages and covered goods waggons have a gangway on the roof, provided with a double handrail, so that the railway officials may be able to walk along the train whilst in motion.

At a height of 3,260 feet the line crosses the river Loa on an iron viaduct 940 feet long, carried on 7 iron piles, of which the two highest are 330 feet. The width of the roadway is 12 feet, and the total weight of the ironwork in the viaduct is 1115 tons.

The railway, as a pioneer line, is a sound commercial undertaking. Although only a single line, it carried in 1892—

416,166 tons of freight	...	...	= 725 tons per mile per annum.
21,741 No. passengers	...	...	= 37 No.      "

The engines working the heaviest gradients weigh 37 tons.

## BROAD-GAUGE AND METRE-GAUGE RAILWAYS IN BRAZIL.

Mr. Hammond bears the following testimony to the success, financial and otherwise, of metre-gauge lines in Brazil:—

“Having been both engineer and manager of broad- and narrow-gauge railways in Brazil for eighteen years, may I give a few facts?

“1. The cost and equipment of the Paulista Railway, 200 miles long, a continuation of the San Paulo Railway, 5 ft. 3 ins. gauge, with curves of 280 metres radius, and a ruling gradient of 1 in 50, was over £9600 per mile.

“2. The cost and equipment of the Rio Claro Railway, 290 miles long, one metre (3 ft. 3 $\frac{1}{2}$  ins.) gauge, with curves 100 metres radius, and a ruling gradient of 1 in 50, was under £3200 per mile. I will not bring in evidence the other narrow (metre) gauge railways in the State of San Paulo, which measure more than 1800 miles, of which 80 per cent. cost less than £4000 per mile, the remaining 20 per cent. costing something more, on account of exceptional circumstances.

“The two railways mentioned above, of which I was general manager and engineer, will illustrate exactly the relative costs of the two systems, because both are constructed in very similar country, namely, the coffee districts of San Paulo—the Rio Claro being an extension of the Paulista.

“The rainfall on both lines varies from 36 ins. to 45 ins. of rain per annum. On both, considerably more than one-half the revenue comes from the carriage of coffee. The speed of the passenger trains on the Paulista broad gauge is 32 miles an hour, and on the Rio Claro narrow gauge 22 miles an hour.

“The rails of the broad gauge weigh from 62 lbs. to 72 lbs. per yard, and on the narrow gauge from 42 lbs. to 47 lbs. per yard. The weights on the driving wheels of the engines are from 5 tons to 5 $\frac{1}{4}$  tons on the broad gauge, and from 3 $\frac{1}{4}$  tons to 3 $\frac{3}{4}$  tons on the narrow.

“The sleepers of the broad gauge have twice the amount of wood in them that the narrow gauge have. Both have Vignoles section rails, held in place by simple dog spikes.

“Both have paid from 10 to 14 per cent. dividends to their shareholders. This last fact demonstrates that both are suitable for the work they do. Had the Rio Claro been made broad gauge, like the Paulista, its capital would have been increased to three times, and the shareholders, instead of receiving handsome dividends, would have been ruined.

“It must be mentioned that the working of the trains on both lines is similar—that is, both have engine-drivers, and firemen, and guards, in proportion to the length of the train.

“The above shows that narrow-gauge lines are very satisfactory, and just as commercially successful as the broad, with the tremendous fact in their favour that their cost is only one-half. All the lines now being constructed, or in contemplation, in Brazil, are of the narrow gauge.

“In the suburbs of the city of San Paulo, Brazil, there is a railway, or tramway, which runs for a considerable part of its length on a high-road, where there is a large traffic of carts and vans always going on. On the engine there is but one man, who is both driver and fireman, and the waggons and carriages are under the control of one guard. The train stops anywhere for passengers, and has very

primitive stations, where the goods are received or delivered. The line answers its purpose admirably. The curves are very sharp, and there are gradients as steep as 1 in 28.

"Such a system could be made in England at a cost of less than £1500 per mile, by following the highways as much as possible, by avoiding the useless luxuries, for a single line, of locking points, of signals, of fancy stations, of overhead bridges, and of a great staff on the trains, and would be an immense benefit to the farmers ; whereas, the cheapest and flimsiest extension of the normal 4 ft. 8½ ins. gauge, if made to carry the waggon stock of the great companies, would cost so much that a dividend could not be earned, and inevitable failure would be the end."

#### COLONIAL RAILWAYS—NEW ZEALAND.\*

It was originally proposed to construct the railways in New Zealand of a cheap description. A gauge of 3 ft. 6 ins. was decided upon, with 40-lb. rails, sharp curves, steep gradients, and low speeds. It was assumed that £5000 per mile would be the cost, with extras for exceptionally heavy works.

To overcome a very difficult point on the line from Wellington, a gradient of 1 in 15 for 2½ miles occurs, and is worked by a Fell engine with centre rail. The alternative, with a gradient of 1 in 40, would have involved a succession of curves of 3 chains radius, nineteen tunnels, and many embankments 100 ft. deep on the centre line, and the length of the line would have been 8½ miles. The saving in cost by adopting the steeper incline was probably £100,000.

The colony has a large mileage of railways in proportion to the population. The active competition of water carriage at many points, where the railways follow the coast, and the extension of other lines inland, to mountainous and pastoral districts, at present almost devoid of population, accounts for the unfavourable appearance of many of the figures relating to traffic receipts.

In the remotest parts, trains only run once a week, and even on the busiest parts they run only during sixteen hours per day ; the heavy traffic is towards the ports, and a very moderate traffic in small lots forms the greater part of the return traffic. The average non-paying load to the paying load per waggon is as 2 to 1.

The average cost per engine mile for all locomotive expenses is

\* "Government Report on Railways for year 1893." *Min. Proc. Inst. C.E.*, vol. lxiii.

as 9·55d., including the Fell engine services, on the Rimutaka incline of 1 in 15 of  $2\frac{1}{2}$  miles.

The Fell engines weigh 36 tons, and draw 70 tons up 1 in 15 at the rate of 5 miles per hour. These engines ran 17,900 miles in one year, costing 3s. 10d. per engine mile.

The rails originally laid on the railways were 40-lb. iron, but all renewals are 53-lb. steel.

**The Auckland Section** has a large proportion of its length in unsettled country with little traffic. The maximum gradients are 1 in 40.

**The Napier Section**, for half its length, penetrates into a fertile country, it has neither water competition nor any non-paying branches. The maximum gradients are 1 in 45. On the other half, the district is as fertile and productive, but it is subjected to much water competition. It has many sharp curves and steep gradients, the maximum gradient being 1 in 33.

**The Wellington Section** has a traffic similar to the Napier. It, however, crosses a mountain range for a distance of 18 miles, with gradients of 1 in 33 and 1 in 40, and a gradient of 1 in 15 against the chief traffic, with curves of 5 chains radius.

**The Hurunui-Bluff Section** has agricultural traffic of considerable volume, but it has numerous short branches penetrating into sparsely populated pastoral districts, with light traffic. The line passes many seaports, so that the average distances over which the traffic is carried are short, the maintenance charges due to long and expensive bridges are heavy, and portions of the line are subjected to floods.

The maximum gradients are 1 in 50, with curves of  $7\frac{1}{2}$  chains radius in the central part; but in the northern and southern parts the gradients are flat.

Brown coals, costing 7s. 6d. to 8s. 6d. per ton at the pit mouth, are largely used for locomotive purposes.

**The Extensions**, while generally of great advantage to their respective localities in opening up new country, and giving access to timber, coal, and settlement areas, thereby enlarging the productive powers of the colony, do not, and cannot be expected to add, much to the net profit, until such time as these resources and their

attendant industries are developed. In such cases, the question is not so much, "Will a railway pay?" as "Is the district worth opening up by such means?"

There are extensive areas in the colony, especially in the North Island, which, for productive purposes, are useless until opened out by roads and railways.

#### **The Fell Engine on Rimutaka Incline.\***

*Distance, 3 miles; gradient, 1 in 15; curves, 5 chains radius.*

The traffic over the incline, both ways, is equal to 50,000 tons of net-paying load per annum. The cost of the locomotive for this service is equal to 4*d.* per ton of net-paying load per mile. The passenger tonnage is calculated proportionately to the non-paying load carried, as compared with goods tonnage.

During the descent, the steam is used in the cylinders for lubrication, and jets of water are played on the centre rail, just in advance of the brake, which cool the rail and saturate the longitudinal sleepers, preventing them taking fire. The brake also works more smoothly on a wet rail, and lasts three times as long as on a dry one; water is likewise used on the trailing-wheel tires, both when ascending and descending, which wets the rails for the vehicles following. The wear of rails and tires is considerably lessened by the free use of water, and the train friction is reduced. The centre engine of the locomotive can take alone 40 tons, and the outside engine, by adhesion only, 30 tons.

The loads are all hauled, when two or three locomotives are used; each locomotive is so placed as to haul its own load. Forty-five minutes are allowed between the stations for ascending goods trains, with a gross load of 65 tons, exclusive of the weight of the locomotive. Loads of 70 tons per locomotive are often taken up, but this is a maximum effort. Mixed ascending trains are allowed forty minutes, and a load of sixty tons.

Trains are worked with one, two, or three locomotives, according to the loads, without inconvenience; the locomotives being placed so as to divide the train, and to prevent overstraining of drawbars.

\* *Min. Proc. Inst. C.E.*, vol. xcvi.

The traffic is somewhat intermittent. A large portion being of live stock, having to be sent through without delay, at times entails three engines being in steam, which have not nearly full work. A continuous traffic, which would allow of one or two engines being kept constantly at work, would be carried on very much more cheaply.

The capacity of such an incline for traffic will be limited by its length amongst other things. An incline from 2 to 3 miles long, up which are conveyed loads of say, 180 tons, with an allowance of  $1\frac{1}{2}$  hours for a double trip, is equal to the accommodation of an ascending traffic of 1440 tons of gross load per day of twelve hours.

TABLE M.  
PARTICULARS OF COST, REVENUE, AND WORKING EXPENSES, ETC., OF LOCAL RAILWAYS IN NEW ZEALAND.

NAME OF RAILWAY.									
	Auckland District.	Napier District.	Wellington District.	Haruru-Bluff District.	Nelson Branch.	Picton Branch.	All railways.		
Miles open	288	332	92	11,01	23	21	1948		
Cost per mile, including rolling stock	£7175	7410	11,658	7616	7200	9753	7771		
Receipts per mile, passengers	170	309	418	220	173	128	235		
", Goods	276	315	522	391	240	205	378		
", sundries		—	—	—	—	—	—		
Gross earnings	446	624	940	611	413	385	613		
Working expenses	290	394	583	376	422	340	384		
Net earnings	156	230	357	235	—	—	229		
Gross earnings	6	5	7 1	6 10	7 9	4 10	5 5	7 6	
Working expenses	4	3	4 6	4 3	4 9	4 11	5 6	4 9	
Net earnings	2	2	2 7	2 7	3 0	—	—	2 9	
Working expenses of gross earnings	£2 1 2	65·05	63·19	61·99	61·98	102·04	101·37	62·70	
Net return on capital	114·18	159·55	167·42	138·84	187·51	176·36	140·35		
Maintenance	£	62·13	102·10	186·18	89·58	77·54	59·10	92·97	
Locomotive power	24·90	32·22	53·81	25·05	20·99	24·13	29·52		
Repairs and renewals of waggons and carriages	76·19	88·72	142·59	112·61	122·20	70·54	105·18		
Traffic charges	10·24	18·81	22·04	14·31	10·84	6·76	14·12		
General charges	2·40	3·28	10·91	1·10	3·05	2·98	2·32		
Other charges	19·94	21·68	14·56	20·46	26·40	34·14	20·70		
Maintenance	10·85	13·88	16·18	13·69	10·92	11·44	13·71		
Locomotive power	4·35	4·38	4·68	3·83	2·95	4·67	4·85		
Repairs and renewals of waggons and carriages	13·30	11·39	12·40	17·22	17·21	13·66	15·51		
Traffic charges	1·79	1·88	1·91	2·19	1·53	1·31	2·08		
General charges	0·42	0·45	0·95	0·17	0·43	0·58	0·34		
Other charges	total	No. tons	No. tons	No. tons	No. tons	No. tons	No. tons		
Passengers carried per annum	427,479	752,746	421,945	2,095,587	65,107	40,799	3,989,927		
Tonnage of goods and live stock	157,989	214,043	85,468	1,204,572	13,181	15,333	21,287,709		
Passengers carried per annum	No. per mile	No. tons	No. tons	No. tons	No. tons	No. tons	No. tons		
Tonnage of goods, etc., per annum	"	548	645	4,586	1,903	2,850	1,942	2,048	
Train mileage per annum	"	1,302	1,763	2,651	1,569	571	634	1,093	
		train miles				1,704	1,224	1,598	

## SOUTH AUSTRALIA.\*

The railways in this colony were commenced in 1854, on the 5 ft. 3 ins. gauge. The permanent way was originally of 65-lb. rails laid on longitudinal sleepers, and of 65-lb. double-headed rails, cast-iron chairs, and cross sleepers. The railways up to 1864 had cost £12,000 per mile, when it was decided to initiate a cheaper system.

1st. By the extension of the then existing system on the same gauge, but of lighter type, costing not more than £5500 per mile, including stations and equipment.

2nd. By the 3 ft. 6 ins. gauge for independent systems.

The first 5 ft. 3 ins. gauge line (70 miles) on this principle cost £5247 per mile, and, being an extension of the existing system, only a small amount of additional rolling stock was necessary. The line ran through a very easy country, with one large bridge crossing a ravine 80 ft. deep, with two openings of 150 ft. each, and costing £14,000. The gradients were not steeper than 1 in 100, excepting three-quarters of a mile of 1 in 80, and the sharpest curve was 20 chains radius.

The permanent way had rails 40 lbs. per yard, spiked to redwood, hard-gum sleepers, 9 ft.  $\times$  9 ins.  $\times$  4½ ins., spaced 2 ft. 9 ins. apart, and a sleeper under the joints, with 8 ins. ballast underneath, of limestone broken to 2½ ins. gauge.

Stations were built every seven miles, with goods sheds from 60 to 100 ft. long. The foundations up to 3 ft. above rail level were of stone, upon which the side and end walls were built of wood frames covered with galvanized iron, 24 B.W.G. The roofs 45 ft. span, with circular wrought-iron principals, 10 ft. apart, were covered with similar iron. The other station buildings were, a station-master's house in stone, with booking-office and waiting-room in iron. The line was fenced with iron fencing.

The low-sided waggons weighed 4 tons 4 cwts., and carried 7 tons, but were limited in practice to 6 tons. The locomotives were of 26 tons weight in working order, four wheels coupled and a bogie, with tenders weighing 19 tons, and capable of hauling 68 tons up 1 in 50 at 10 miles per hour. It was originally intended to work the line

\* "Government Report on Railways for 1893." *Min. Proc. Inst. C.E.*, vol. lvi.

with 20-ton engines, running 10 miles an hour with goods and 20 miles with passenger trains, having no greater axle weight than 7 tons, but public pressure led to the use of heavier engines and higher speeds, even up to 20 miles an hour with goods and 35 with passenger trains.

The line runs through a good wheat country, and, five years after opening, carried 97,238 tons, and 76,223 passengers. So great was the wear of the iron rails, under the heavy engines and fast speed, that the line was relaid as required with 60-lb. rails, commencing after only eight years' wear. Experience showed that a 40-lb. iron rail was serviceable as long as the speed of goods trains was limited to 15 miles and passenger trains to 20 miles per hour, and when no axle carried a greater weight than 5 tons.

The following table gives the cost of other lines on this gauge, including stations and rolling stock, constructed between 1864 and 1878:—

	Gauge.	Per mile.	Rails.		
				ft.	ins.
Goolwa and Victor .. ..	5 3	5385	35	Line worked by horses.	
Roseworth and Burra ..	5 3	5169	40	No. 1 section.	
"      " ..	5 3	5604	40	No. 2   ,,	
Burra and Hallet .. ..	5 3	5000	40	—	
Rapunda and North-West Bend	5 3	5861	40	—	

The narrow-gauge railways were to cost not more than £5500 per mile. The estimate for one from Port Augusta, for a distance of 200 miles, made in 1877, was £5042 per mile, and the capital account of the line now is £5228 per mile, so that the work must have been carried out for the original estimate in the first instance.

The estimate per mile was—

		£
Land and fencing .. ..	...	17
Earthworks .. ..	...	785
Bridges and culverts .. ..	...	830
Permanent way, including sidings .. ..	...	2305
Stations and water supply .. ..	...	515
Rolling stock .. ..	...	350
Engineering .. ..	...	240
		£5042

The steepest gradient is 1 in 60, and the sharpest curve 5 chains radius.

Most of the land belonged to the Crown, and only private lands were fenced. The earthworks were generally of a light character. Bridges and culverts were numerous, there being 8750 lineal feet of iron bridging, and 570 culverts, mostly 10 ft. diameter, on the entire length.

The bridges had masonry abutments, piers of hollow cast-iron screw-piles, and a superstructure of wrought-iron plate or lattice girders. For simplicity and economy, only 20, 40, and 60 ft. spans have been adopted. The speed of passenger trains is limited to 20 miles an hour, and goods trains to 14 miles. The greatest load for the bridges has been taken at 15 cwt. per lineal foot.

The permanent way consists of 40-lb. rails spiked to hardwood cross sleepers 6 ft. 6 ins.  $\times$  8 ins.  $\times$  4 ins., 2 ft. 9 ins. apart, with 6 ins. ballast under the sleepers.

The locomotives have six wheels coupled, 3 ft. 3 ins. diameter, with a two-wheel Bissel bogie in front. The cylinders are 12 ins. diameter, 20 ins. stroke, and are equal to a gross load of 85 tons, exclusive of engine and tender, up 1 in 50, at 10 miles per hour. They weigh 19 tons in working order, and carry 850 gallons of water.

The passenger carriages (21 ft. 6 ins. long  $\times$  8 ft. wide) have longitudinal seats, with a centre passage, carrying 30 passengers, and weighing  $5\frac{3}{4}$  tons, or 429 lbs. per passenger. The waggon stock is of three types.

			Empty.	Live load.	Ratio.		
	ft. ins.	ft. ins.	ft. ins.	tons cwt. qrs.	tons cwt. qrs.		
Low-side waggons ..	14 0	$\times$	7 0	$\times$ 1 6	2 17 0	6 0 0	1:2.1
Medium ..	14 0	$\times$	7 0	$\times$ 2 6	3 3 0	6 0 0	1:1.9
Covered vans ..	14 0	$\times$	7 0	$\times$ 6 0	3 10 0	5 0 0	1:1.7

The underframes of carriages and waggons are of iron, and the uniform wheel-base is 7 feet.

The stations occur at intervals of 20 miles, with station-master's

house, booking-office, and goods shed, etc. There are terminal workshops, with engine and carriage sheds, and provision is made for erecting houses along the line for the repairers.

The water supply forms a very serious item, and includes the construction of large covered concrete tanks, each with a capacity of 600,000 gallons, with overhead tanks and steam-pumps complete, every 20 miles. The amount of £5042 per mile includes the whole of these works, and also the complete equipment of the line.

The conclusions arrived at in the working of the railways in South Australia is that, in opening up new countries, it is a mistake to adopt so wide and exceptional a gauge as the 5 ft. 3 ins.

For poor countries, where the greatest economy in construction and in maintenance is necessary, and where time is of no great value, a gauge of 3 ft. 6 ins. with a 40-lb. rail, would probably be the best type of line that could be adopted. But for countries capable of a considerable degree of development, and that have the promise of a large population and future wealth, there can be no doubt of the wisdom of adopting the 4 ft. 8½ ins., with a section of rail in proportion to the power and weight of the engines employed, and the speed desired.

If no axle carries a greater weight than 5 tons, and the speed is limited to a maximum of 15 miles an hour for goods and 20 miles for passenger trains, then a 40-lb. iron rail with a layer of 6 ins. of ballast under the sleepers, will, with the ordinary amount of traffic in a new country, last from twelve to fifteen years, or, if steel rails are employed, for a much longer period.

If more powerful engines and higher speeds are required, the weight of rail and the quantity of ballast must be increased in proportion, but a 60-lb. rail on this gauge of 3 ft. 6 ins., with 9 ins. depth of ballast under the sleepers, would amply suffice for the conduct of the heaviest traffic that could arise in the wealthiest of these colonies, travelling at the rates of speed common upon English railways.

The following table gives the cost of other lines on this gauge, including stations and rolling stock, constructed between 1867 and 1878:—

	Gauge.	Cost per mile.	Rails.	Remarks.
Port Wakefield and Blyth, No. 1	ft. ina.	£	lbs.	
	3 6	3548	40	Through level country.
Port Broughton and Barunga ..	2	3 6	6343	—
Kingston and Narracote ..	..	3 6	5579	35
Port Augusta and Farina ..	..	3 6	3623	35
Rivoli and Mount Gambier ..	..	3 6	5042	40
Hamley Bridge and Balaklava ..	..	3 6	4030*	40
Kadina and Black Point ..	..	3 6	4465*	40
		3 6	3823*	40

The broad-gauge railways are being relaid with 60-lb. rails, and near Adelaide, where the suburban traffic is considerable, with 80-lb. rails; and the narrow-gauge lines with 50-lb. rails.

The following statement will show the results of working railways in the Australian Colonies.

	South Australia.	Victoria.	New South Wales.	Queens-land.	New Zealand.	Tasmania.
Gauge .. .. ..	5 3 3 6	5 3	4 8½	3 6	3 6	3 6
Per centage of working expenses to revenue	56.98	59.99	56.58	62.61	62.70	89.73
Net revenue on capital	3.54	2.89	3.46	2.17	2.89	0.44
Maintenance per mile per annum .. ..	£155 £72	£174	£218	£133	£146	£146

The maintenance of the lines in this colony, compares very favourably with those in the other colonies, and is considered by the Commissioners to be due to the effective system of supervision which is in operation; and "we cannot state too emphatically that if the present system were altered, as has been suggested, by placing in such responsible positions, as those occupied by the resident-engineers, non-professional men, the experiment would undoubtedly prove, as it did in the past, both unsatisfactory and costly."

**Palmerston and Pine Creek Railway.**—This railway has been constructed from Port Darwin, in the northern division of South Australia, and is, of course, entirely isolated from the other railways,

\* Country very level throughout. Timber bridges used for crossing creeks and waterways.

which are all constructed in the southern division. The railway has a traffic of only £111 per mile per annum, but with this revenue it manages to pay working expenses, and to contribute £33 per mile per annum towards the payment of interest.

The line is on the 3 ft. 6 ins. gauge, and is 145 miles long. It was opened in 1889.

The expenditure on the railway and equipment, including a jetty at Port Darwin, has been as under, to June, 1894—

		Total.	Per mile.
		£	£
Ways, works, and buildings, including jetty	...	960,902 or 6600	
Rolling stock	...	31,070	210
Machinery and plant	...	12,020	80
Interest during construction	...	£136,597	
Discounts and floating charges	...	5388	141,985
			, 990
Total expenditure	...	£1,145,977	, £7880

The cost of the jetty is not given separately, but the amount raised for this item in 1884 was £57,000.

The **working expenditure** was as follows:—

Maintenance.			
		Per mile.	Per train mile.
		£	d.
Engineering and supervision	...	1339	
Way—Ballasting	...	104	
Weeding	...	700	
Sleepers	...	90	
Rails	...	7	
Platelaying	...	1985	2886
Works—Clearing	...	184	
Fencing	...	8	
Earthworks	...	655	
Bridges, etc.	...	157	
Roads	...	3	
Jetties and wharves	...	109	1116

Buildings.			
		£	
Traffic	...	15	
Locomotives	...	4	
Maintenance	...	4	
Residences	...	164	187
Rolling stock	...	34	
Machinery and plant	...	4	
Reservoirs, etc.	...	5	
Improvements	...	228	
			£5799
			40 44·45

*Locomotive Power.*

		£	£	Per mile. £	Per train mille. d.
Superintendence and office expenses	...		610		
Running—Drivers, firemen, and cleaners	843				
Stores	...	...	70		
Fuel	...	...	494		
Water	...	...	69	1476	
Repairs and renewals	...	...	603		
" shop charges	...	...	87	690	
		<u>£2776</u>		19	21.45

*Carriage and Waggon.*

Superintendence and office expenses	...	93		
Shop charges	...	38		
Carriages, repairs, and renewals	...	76		
Waggons,	"	<u>271</u>		
		<u>£478</u>	3	3.69

*Traffic Expenses.*

General traffic manager's office	...	31		
Traffic officers	...	825		
Guards, porters, and others	...	514		
Printing and stationery	...	40		
Sundries	...	<u>626</u>		
		<u>£2036</u>	13	15.73

*General Charges.*

Commissioner's office	...	38		
Comptroller's office	...	281		
Sundries	...	<u>4</u>		
		<u>£323</u>	2	2.50

The train mileage was—

Passengers	15206		
Goods	...	<u>15850</u>	
		31,056, equal to a train each way twice a week.	

**Revenue.***Passengers, etc.*

		No.	£	Per mile. £	Train mile. d.
Passengers, 1st class	...	323	425		
" 2nd "	...	3753	1573		
" excess fares	...		866		
Parcels and cloak-room charges	...		329		
Mails	...		475		
Police and military subsidies	...		145		
Sundry earnings	...		<u>7</u>		
		<u>4,076</u>	<u>£3820</u>	<u>26</u>	<u>60.29</u>

Goods.					Per mile. £	Train mile. d.
		Tons.	£		£	
Minerals	...	...	34	34		
Grain	...	...	71	159		
Goods, other than above	...	...	2241	9425		
Cattle, calves, and horses	...	...	793			
Other live stock	...	178	69	642		
					2524	— £10260
						70
						155·36

## Summary.

	£		
Passengers	3820		
Goods	10260		
Rents	800		
Sales of water	185		
Wharfage	1128		
		—	—
Total revenue	£16193		111 125·14

## Working Expenses.

Maintenance	5790	40	44·75
Locomotive power	2776	19	21·45
Carriage and waggon repairs	478	3	3·69
Traffic expenses	2036	14	15·73
General charges	323	2	2·50
	£11403	78	88·12
Net revenue	£4790	33	37·00

The *average mileage* travelled by a *passenger* was 44·65 miles, and the *average receipts* 2·64*d.* per passenger per mile. The *average mileage per ton* was 116·04 miles, and the *average receipts* 8·41*d.* per ton per mile.

The rolling stock consisted of—

6 locomotives.

7 coaches.

134 waggons.

There are fifteen stations or stopping places on the line, and the total staff consisted of—

3 men, generally for all branches.

9 „ traffic branch.

13 „ locomotive and carriage.

63 „ maintenance.

88 „ total (35 Europeans, 53 Coolie and Chinese).

TABLE N.  
PARTICULARS OF COST, REVENUE, AND WORKING EXPENSES, ETC., OF LOCAL RAILWAYS IN SOUTH AUSTRALIA.\*

South-eastern system. 3 ft. 6 ins.		Northern system. 3 ft. 6 ins.		Western system. 3 ft. 6 ins.	
Miles open		Midland system. 5 ft. 3 ins.		Southern system. 5 ft. 3 ins.	
Cost per mile, including rolling stock		Palmerston line. 3 ft. 6 ins.		3 ft. 6 ins.	
Passengers per mile, passengers	..	1173	145	232	153
goods	..	492	7880	14,633	5649
sundries	..	..	..	..	..
Gross earnings	..	1665	7297	..	..
Working expenses	..	..	..	..	..
Net earnings	..	..	..	..	..
Gross earnings	..	..	..	..	..
Working expenses	..	..	..	..	..
Net earnings	..	..	..	..	..
Working expenses of gross earnings	..	..	..	..	..
Net return on capital	..	..	..	..	..
Maintenance	..	..	..	..	..
Horse power	..	..	..	..	..
Locomotive power	..	..	..	..	..
Repair & renewals of waggons & carriages	..	..	..	..	..
Traffic charges	..	..	..	..	..
General charges	..	..	..	..	..
Other charges	..	..	..	..	..
Maintenance	..	..	..	..	..
Horse power	..	..	..	..	..
Locomotive power	..	..	..	..	..
Repair and renewals of waggons, etc.	..	..	..	..	..
Traffic charges	..	..	..	..	..
General charges	..	..	..	..	..
Other charges	..	..	..	..	..
Passengers carried per annum	..	..	No. tons	..	..
Tonnage of goods, etc.	..	..	No. tons	..	..
Passenger carried	..	..	No. tons	..	..
Tonnage of goods, etc.	..	..	No. tons	..	..
Train mileage	..	..	train mls.	..	..

\* Compiled from Government Report on Railways for 1893.

TABLE O.  
CONSUMPTION OF FUEL, ETC., ON THE BROAD AND NARROW GAUGE RAILWAYS OF SOUTH AUSTRALIA.

Average load, including engine and tender.	5 ft. 3 ins. gauge.						3 ft. 6 ins. gauge.					
	Per mile.			Per 100 tons per mile.			Lubricants.			Relative cost of consumption per 100 tons per mile.		
	Coal.	Coke.	Wood.	Total.	lbs.	lbs.	Oil in pints.	pints	lbs.	pints	lbs.	d.
Adelaide Terowie and Dry Creek, passenger, mixed, and goods ..	202	29.94	0.21	1.34	31.49	16.63	5.93	1.87	1.67			
Port Semaphore and Dry Creek, passenger .. .. ..	144	10.11	24.28	2.40	36.79	25.90	8.75	2.93	2.57			
Adelaide, Strathalbyn, and Servicetown, passenger and goods .. .. ..	163	41.53	0.21	1.89	43.63	27.93	5.81	2.74	2.78			
Strathalbyn and Milang, mixed .. .. ..	77	18.42	—	4.27	22.69	29.50	6.00	4.42	3.21			
Western system .. .. ..	147	24.89	—	1.73	26.62	18.70	2.85	2.08	1.84			
Northern .. .. ..	185	25.08	—	1.40	26.48	14.70	4.48	2.48	1.53			
South Eastern .. .. ..	137	20.21	—	1.99	22.20	16.63	1.51	0.93	1.57			

## INDIAN RAILWAYS.\*

The railways of India are constructed on gauges 5 ft. 6 ins., 3 ft. 3½ ins., 2 ft., and 2 ft. 6 ins. Full information of the reasons for adopting the different gauges, will be found in the *Proceedings of the Institution of Civil Engineers*, and it is not necessary here to enter into them. The railways have been constructed under different systems, and at present (1894) the position stands thus, in round figures :—

	Standard. 5 ft. 6 ins.	Metre. 3 ft. 3½ ins.	Special. 2 ft. and 2 ft. 6 ins.	Total.
State lines worked by Companies .. ..	3423	5183	—	8606
" the State .. ..	3877	1294	28	5199
Lines worked by guarantee Companies .. ..	2587	—	—	2587
Assisted Companies .. .. ..	184	168	51	403
Lines owned by Native States, and worked by Companies .. .. ..	402	188	72	662
Lines owned by Native States, and worked by State Railway Agency .. ..	124	—	22	146
Lines owned and worked by Native States	—	744	94	838
Foreign lines .. .. ..	—	—	59	59
Total mileage ..	10,596	7637	267	18,500

And, in addition, 51 miles of steam tramways outside municipal limits.

The following lengths of new lines were opened last year :— Standard, 247; metre, 183; special, 22; total, 452 miles. And the following have been sanctioned : Standard, 11; metre, 143; special, 9; total, 263 miles.

The average cost per mile of railway open, excluding steamboats, was—Standard, Rs.1,60,971; metre, Rs.70,584; special, Rs.31,627.

The standard gauge includes 1140 miles of double line, and the metre gauge 10 miles.

The cost per mile of single track, including sidings, being— Standard, Rs.1,24,279; metre, Rs.62,777; special, Rs.30,013.

The gross earnings were — Standard, Rs.17,82,77,906; metre, Rs.6,12,79,625; special, Rs.12,84,761.

The number of passengers carried—Standard, 88,454,834; metre, 46,245,635; special, 819,978.

The tonnage of goods, material, and live stock — Standard, 21,242,685 tons ; metre, 7,484,701 tons ; special, 119,343 tons.

The percentage of expenses on gross earnings under the several heads was—

		Standard.	Metre.	Special.
Maintenance ..	.. .. .. ..	12.08	12.52	12.10
Locomotive ..	.. .. .. ..	15.20	17.06	17.10
Carriage and waggon ..	.. .. .. ..	4.21	4.34	4.91
Traffic ..	.. .. .. ..	7.50	8.14	9.99
General ..	.. .. .. ..	4.37	6.76	9.03
Steamboat, special, and miscellaneous, etc..	.. .. .. ..	1.83	1.89	2.03
Contribution to Provident Fund ..	.. ..	0.49	0.41	0.24
Total .. ..	45.68	51.12	55.40	

The statistical return on the capital, including steamboat service, and suspense accounts is—Standard, 5.48 ; metre, 5.38 ; special, 6.63 per cent.

The results show a net loss of 84½ lakhs of rupees.

The loss on guaranteed railways is attributable to the high rate of interest guaranteed ; to the increased cost, as compared with previous years of remitting the interest, at the very low rate obtained, and estimated to be obtained, for council bills on India ; and to the fact that the companies' share of surplus profits is, under the contracts, calculated on the supposition that earnings could be remitted in payment of interest at a rate of 1s. 10d. the rupee.

The State has to continue to pay interest at the guaranteed rates until the contracts terminate, and it is consequently unable to obtain any advantage from cheaper money, and the improved credit of the country ; that is to say, where the State could now raise money at a little over 3 per cent., to pay off loans raised at higher rates of interest, it has to continue paying interest at the high average rate of about 4½ per cent. on the capital, raised by the guaranteed companies ; and now, owing to the fall of exchange, the amount of rupees which have to be remitted to England, to pay the sterling interest charges, is equivalent to a payment of interest of about 7 per cent. on the total capital raised, converted at the contract rate of exchange.

But if we convert the transactions of the guaranteed companies

from Indian currency into sterling, at the contract rates of exchange, the guaranteed lines show a net revenue of £3,046,225. The guaranteed interest is £2,157,007, and the net earnings are in excess of the guaranteed interest by £889,218. This, however, does not represent the true facts of the case, as the figures do not take into account the heavy loss by exchange, in connection with the guaranteed interest paid in England.

The standard-gauge railways run through the main arteries of traffic, and have been constructed in other districts for military convenience, to avoid break of gauge. They are fully up to the condition of the first-class railways in this country, both as regards construction, equipment, and working. Originally laid with 60-lb. rails, they are now relaid with rails weighing from 75 to 100 lbs. The East Indian has 85-lb. rails, is a double line for 474 miles of its length, and is one of the most important traffic-carrying railways in the empire.

The metre-gauge lines have been carried through districts where little traffic was expected at first. They are fully equipped, substantially constructed, and travelling on them, though slow, is very comfortable. They are relaid with 50-lb. rails as required, instead of the original 36-lb. or 40-lb. The Rajputana Malwa is the principal metre-gauge railway.

The special-gauge railways have been constructed in less-developed or more isolated districts, or in places where a line of a broader gauge was almost a financial impossibility, as in the case of the Darjeeling Himalayan Railway.

It is interesting to note that the special-gauge railways have cost per mile less than half that of the metre, whilst the metre have cost less than half that of the standard gauge. On the other hand, the traffic per mile on the standard is double that on the metre, and that on the metre nearly double that on the special gauges; whilst the returns per cent., after paying working expenses, are higher on the special, and about equal on the metre and standard gauges. From this it would seem that the several gauges are well apportioned to the work required of them, and that the substitution of the metre for the special, or the standard for the metre, with their larger capital cost, would not give the same good results.

Tables P, Q, R, give particulars of cost of construction, revenue, and working expenses of some railways on the four gauges.

**The Rajputana Malwa** is the chief metre-gauge line, both on account of its length, the volume of its traffic, and the net returns on its capital. A few notes descriptive of this railway will serve as an illustration of these lines.

The rails originally laid in 1872 were 36 lbs. per yard, but these have all been replaced by 41½ lbs. and all future renewals are to be 50-lb. rails. The length of the line is now 1674 miles, and has a capital cost of £6936 per mile, including rolling stock. Up to the end of 1876, when only 400 miles had been opened, the cost was £5700 per mile. The ruling gradient was then 1 in 150, and the minimum radius of curve 1000 feet. These favourable gradients and curves have not been maintained in the extensions, and gradients of 1 in 40 (one having a length of 3½ miles), and 5-chain curves are frequently introduced.

The cost of construction in June, 1876, with 36-lb. and 40-lb. rails, deodar sleepers, 6 ft. × 8 ins. × 4 ins., laid 2 ft. 9 ins. apart, with 6 ins. ballast under the sleepers, was—

							Per mile. £
Preliminary expenses	...	...	...	...	...	...	64
Land	...	...	...	...	...	...	98
Earthwork	...	...	...	...	...	...	232
Minor bridges	...	...	...	...	...	...	188
Larger ”	...	...	...	...	...	...	917
Level crossings	...	...	...	...	...	...	40
Fencing	...	...	...	...	...	...	31
Ballasting	...	...	...	...	...	...	221
Permanent way	...	...	...	...	...	...	2097
Stations and buildings	...	...	...	...	...	...	555
Electric telegraph	...	...	...	...	...	...	4
Plant	...	...	...	...	...	...	85
Locomotive stock	...	...	...	...	...	...	241
Carriage and waggon stock	...	...	...	...	...	...	442
Establishment	...	...	...	...	...	...	473
Contingencies	...	...	...	...	...	...	26
							<u>£5714</u>

The passenger traffic was carried on by mixed trains, at a speed of 15 miles an hour between stations, whilst goods trains ran 12 miles an hour.

Since this time, with further extensions, the line has wonderfully improved, and the traffic now is equal to nearly £900 per mile per annum, or three times its former traffic per mile; and so great is the press of traffic on a section 500 miles long, that the doubling of this portion is under consideration. The number of passengers carried per annum is 10,070,473, and the tonnage of goods, 1,835,100, and the working expenses are 41·12 per cent. of the receipts.

The large bridges on the line were many, and rendered the construction of the railway more expensive than usual.

Both at Delhi and at Agra, the transhipping is done by bringing the broad and narrow trucks alongside a covered platform 30 ft. wide. The cost of transhipping, including damages, hand-shunting, and loss, is 1½d. per ton.

The station buildings and arrangements are on an economical scale, and there are repairing shops at Agra and Delhi.

The following were the leading dimensions of the rolling stock in 1876:—

				Coaches.	Goods waggons.
Height of floor above rails .. .. ..	feet	2 6	2 6		
Total height from rail .. .. ..	"	9 0	9 0		
Width over all, outside .. .. ..	"	6 8	6 8		
Width inside .. .. ..	"	6 1	6 1		
Length outside .. .. ..	,	18 0	14 0		
Wheel-base .. .. ..	"	10 0	8 0		
Diameter of wheels .. .. ..	"	2 0	2 0		
Weight of first-class carriages .. .. ..	tons	4·7	—		
Weight of second-class carriages .. .. ..	"	4·5	—		
Weight of third-class carriages .. .. ..	"	3·9	—		
Weight of covered goods waggons .. .. ..	"	—	3·0		
Freight carried in goods waggon .. .. ..	"	—	5·0		
Gross load allowed per axle .. .. ..	"	4·0	—		

The average contents of each vehicle then was 2·5 tons, as against 4·2 tons now, showing a very large increase of traffic.

The earnings of the railway in this year were £330 per mile per annum, and the working expenses £187 per mile, as under—

Maintenance.	Locomotives.	Carriage and waggon.	Traffic.	General.	Other.	Total.
£55	65	11	29	24	3	£187

The price of coal was £2 per ton at Agra.

**The Bengal and North-Western Railway** is another metre-gauge line running through comparatively poor districts in the North of Bengal, and practically cut off from the other railway systems by the rivers Ganges and Gogra; the only communication across being by a bridge of boats in fine weather, and by a ferry in the monsoon. The line earns £429 per mile per annum, and is worked at an expenditure of £181 per mile, or 43·20 per cent. of receipts. It has been constructed at a cost of £5016 per mile, including rolling stock. The line runs through an easy country for the first half of its length, and cost under £4000 per mile; whilst the second half had heavy banks and bridging on the lower section, and cost over £6000 per mile. Iron rails of 40 lbs., and steel rails of  $41\frac{1}{4}$  lbs. are used, fixed to wooden sleepers.

The rolling stock is of the following dimensions, and this applies generally now to all the metre-gauge railways in India. The iron-work was obtained from England, and the woodwork, which is of the best Moulmein teak, was provided in India.

The first-class passenger carriages\* are 18 ft. 1 in.  $\times$  7 ft. 0 ins. outside, divided into two compartments, each with a lavatory, and capable of seating twelve passengers, and sleeping eight (Fig. 27).

The seats pull out about 4 ins. to form a wider bed at night.

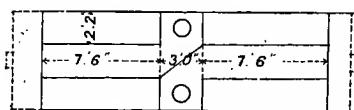


FIG. 27.



FIG. 28.

The saloon carriages are of the same dimensions, but seat eleven passengers, and sleep four;—two couches and five chairs (Fig. 28).

Both the passenger carriages and the saloons have open platforms at each end.

The third-class carriages are of the same dimensions as the others, but are divided into four compartments, with seats 1 ft. 4 ins. wide, 1 ft. 5 in. space between, and carry 32 passengers.

The covered goods waggon is of iron, 14 ft. 0 ins.  $\times$  6 ft. 7 ins. inside measurements, and 9 ft.  $3\frac{1}{2}$  ins. above rail, with a wheel-base

\* The wheel-base is 10 ft.

of 8 ft. The open goods waggon is of the same dimensions, with sides 1 ft. 6 ins. high.

The covered bogie goods waggon is 25 ft. 0 ins.  $\times$  6 ft. 7 ins., (inside), and 9 ft. 3½ ins. above rail.

In all the stock the wheels are 2 ft. 0 ins. diameter.

Height of floor above rail, 2 ft. 6¾ ins.

		Cost of English material, delivered.	Erection charges in India.	Total.
The passenger carriages ..	..	174	160	330
The saloon carriages ..	..	174	192	366
The third class ,," ..	..	96	86	182
The covered goods waggon ..	..	71	7	78
The open goods waggon ..	..	74	3	77
The covered bogie ,," ..	..	155	7	162
The horse-boxes ..	..	102	115	217

The horse-boxes are 19 ft. 3 ins.  $\times$  7 ft. 0 ins. outside dimensions, and carry four horses, standing with their heads towards the centre of the truck.

The locomotives are four-wheel and six-wheel coupled, with tenders, 14 ins. cylinders; 20 ins. stroke. The engines weigh 24 tons and 21 tons respectively, with a rigid wheel-base of 6 ft. and 11 ft., and cost—English material, delivered, £1776; erection charges, £45; total, £1821.

**The Jodhpore (320 miles) and Bickaneer (43 miles) Sections** of the metre-gauge railways, owned and worked by the respective native States, are the cheapest in construction, and have the least traffic, of any metre-gauge line in India, yet the one returns 6 per cent. and the other nearly 3 per cent. on the capital cost.

The lines run through the sandy desert plains of Rajputana. The works of construction were very light, and steel rails 36 lbs. per yard, on steel sleepers, were used.

The details of the cost of construction, revenue, and working expenses, will be found in the Tables P, Q, R.

**The Jodhpore Section**, with a revenue of only £180 per mile, or 3s. 10d. per train mile, is worked at a cost of £86 per mile, or 1s. 10d. per train mile. It carried, last year, 578,578 passengers, and 105,345 tons of goods.

The cost of construction and equipment of this section was £1432 per mile.

**The Bickaneer Section**, with a revenue of £104 per mile, or 2s. 9d. per train mile, is worked at a cost of £63 per mile, or 1s. 8d. per train mile. It carried last year 65,629 passengers, and 10,509 tons of goods.

The cost of construction and equipment of this section was £1586 per mile. The rates on these sections are about 33 per cent. higher than on the other lines of the system.

**Darjeeling Himalayan**.—Of all the local railways in India, the one that stands unique in the adaptability of railway locomotion to practically inaccessible places is the Darjeeling Himalayan. This is a small railway of 2 ft. 0 ins. gauge, running from Siliguri to Darjeeling, a distance of 51 miles. The line runs practically on the level for about 7 miles, when it begins to ascend the slopes of the Himalayas, by gradients of 1 in 23 and 1 in 28.

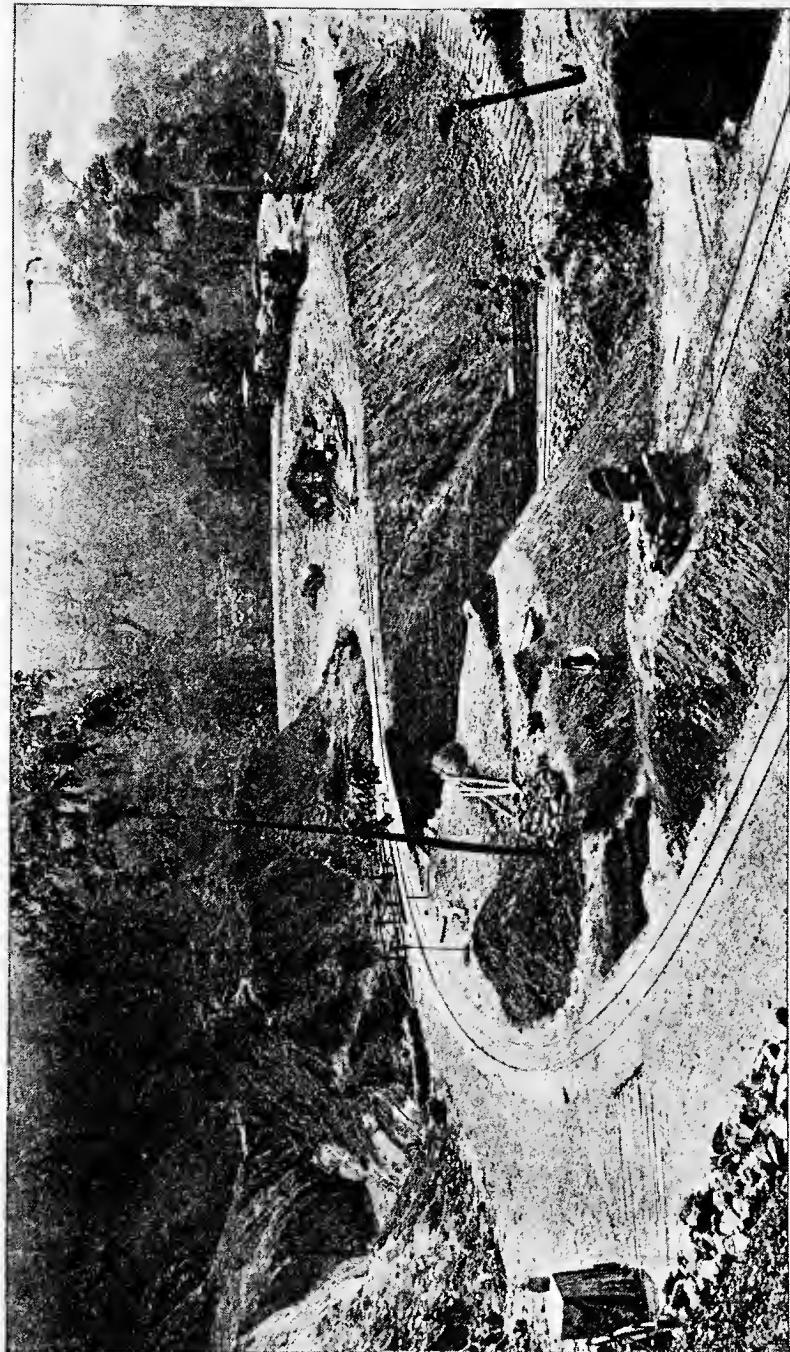
This latter gradient is practically maintained the whole of the way to the summit, and, by the aid of curves of 70 ft. radius, by describing spirals on the spurs of the mountains, and by five reversing stations, it reaches a height of nearly 7000 ft., or a rise of about 6600 ft. in 40 miles.

The line has been constructed along a military road, and its capital cost is about Rs.60,000 per mile = £4000. Of this sum—

Rs.16,900	was for cuttings, banks, and bridges.
13,800	„ ballast and permanent way.
8,000	„ stations.
10,000	„ rolling stock.
11,300	„ other items.
<hr/>	
Rs.60,000	

In its length there are 16½ miles of a continuous average gradient of 1 in 29. The rails were originally 30 lbs. per yard, but all renewals are 40 lbs. It is worked by small adhesion locomotives of 12 and 14 tons' weight, and one of these takes up about 120 passengers in the small, but very comfortable carriages, or a daily load of passengers and goods of 27 tons gross weight. Particulars of the locomotives are given on page 55.

The freight waggons weigh 2000 lbs., or nearly 1 ton, and carry



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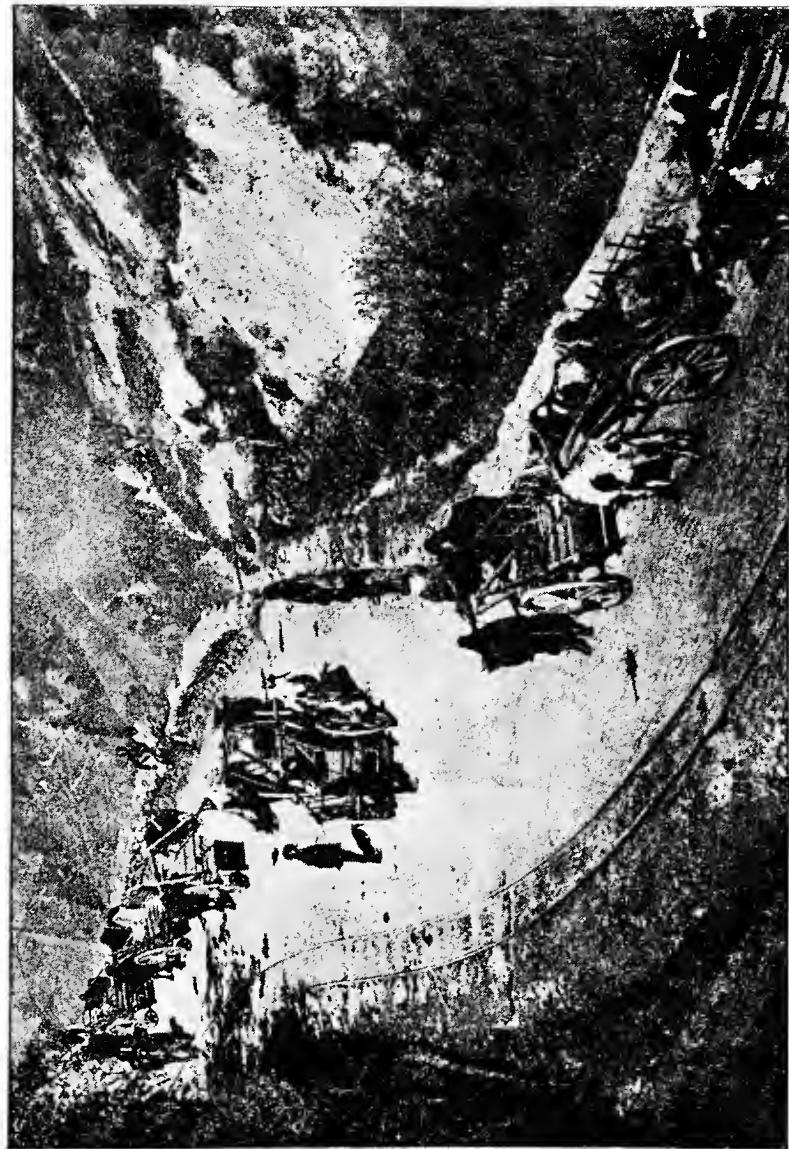
DARJEELING RAILWAY. GAUGE 2 FT.

INK PHOTO. SPRAGUE & CO. LONDON

[Between pp. 198 and 199.



PLATE XXVII.



FROM A PHOTO BY BOURNE & SHEPHERD. CALCUTTA.  
INK-PHOTO SPRAGUE & CO LONDON

DARJEELING RAILWAY. GAUGE 2 FT.

[Between pp. 198 and 199.]





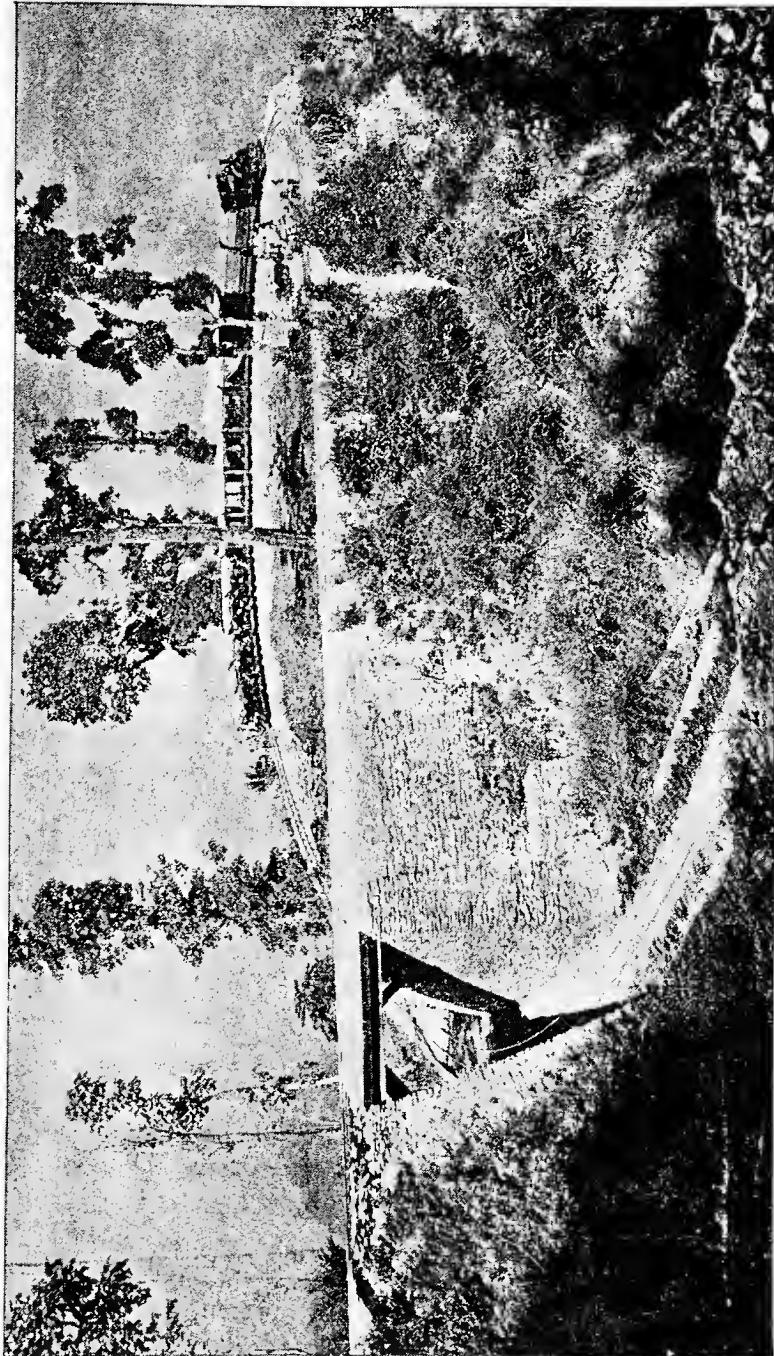
FROM A PHOTO BY BOURNE & SHEPHERD, CALCUTTA.

DARJEELING RAILWAY. GAUGE 2 FT.

[Between pp. 198 and 199.]

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FROM A PHOTO BY BOURNE & SHEPHERD, CALCUTTA.

DARJEELING RAILWAY. GAUGE 2 FT.

INK-PHOTO SPRAGUE & CO LONDON



3½ tons. The passenger carriages weigh (the small open ones, carrying 6 persons, seated in armchairs), 900 lbs. each, and the closed carriages 1 ton. The diameter of the wheels of all rolling stock is 18 ins. The rates in force are much higher than on the other railways in India.

There is a large passenger traffic in the cold season, and a large tea and general merchandise traffic, the revenue being £750 per mile per annum. The time occupied in the journey up is 9 hours, including one hour stoppage for luncheon half-way. Travelling on the gradient is limited to 6 miles per hour, up or down, but on the level a speed of 17 miles per hour is attained. The cost of construction was much cheapened by the line following the old cart road, but the estimate for a similar line from Kalka to Simla, where no cart road is available, through a similar difficult country, is at the rate of Rs.90,000 = now £6,000 per mile.

The alignment of the line has been improved, and is still being improved, but for five years the traffic was worked round a curve of 42 ft. radius, extending over more than half a circle, on a gradient of 1 in 32. The line has paid dividends at the rate of 8 per cent. per annum. Such a combination of narrow gauge, steep gradients, sharp curves, small waggons, and big dividends, is probably unique in the history of railways.

The road along which the railway is made is 25 ft. wide, and was handed over to the Railway Company, free of cost, by the Government. This was a great concession, as in a mountainous district the expenses of excavation and bridging would certainly have cost an extra £2000 per mile, at least. For this concession, the Railway Company divide with the Government half the profits over 5 per cent. (Plates XXVI., XXVII., XXVIII., XXIX.).

Since the railway has been made, the road traffic has almost entirely disappeared, and although the rates charged are considerably in excess of the rates on the railways in the plains (viz. from 5 to 9 times), still they are less than one-half those charged by bullock-cart, and the speed of travelling is five times greater.

If local railways in mountainous districts are to be financially successful, they must be built along the mountain road, as, in many cases, a new alignment would make the expense prohibitive. The

road, of course, would be hampered, to a certain extent, by having the railway upon it; but when the railway is made, the road traffic becomes insignificant, and the necessity for a good road disappears. In the case of the Darjeeling Railway, a good road has been converted into a good railway, and is a source of convenience and profit to the shareholders in it, and also to the Government.

A long and important discussion on the gauge of the Indian railways, took place in the Institution of Civil Engineers, in 1873, when it was proposed by the then Government of India to introduce narrow-gauge railways in future extensions. The mileage of the railways at that time was—

Standard gauge	...	...	...	...	...	...	5326 miles
Metre gauge	...	...	...	...	...	...	17 "
Special gauge	...	...	...	...	...	...	27 "

To-day the mileage of the different gauges is—

Standard gauge	...	miles 10,596	...	an increase of 5,270 miles
Metre	„	„ 7,637	„	„ 7,620 „
Special	„	„ 267	„	„ 240 „

and there have been sanctioned—

Standard gauge	...	...	...	...	...	...	11 miles
Metre	„	„	„	„	„	...	143 „
Special	„	„	„	„	„	...	9 „

It is not necessary here to follow the arguments that were adduced as to the expense to be saved by changing the gauge, but the fact remains that the expenditure on the broad-gauge lines has been more than double that on the narrow gauge. Allowing that the broad gauge was constructed in the early days of railways in India, that it has several portions of its length double, and is altogether a most efficient machine, still the average cost per mile is £13,400 (approximate), as against £5880 for the metre gauge. Several estimates were made at that time as to the difference in cost between the two gauges, comparing like with like, and the estimates ranged from £200 to £1000 per mile.

If the standard-gauge feeder lines are to carry the main-line rolling stock, they must have a rail weighing 50 lbs. per yard, otherwise there will be transhipment; whereas, if the narrow-gauge lines were constructed for the quantity of traffic likely to come upon

them, a 30-lb. rail may suffice, and consequently the saving in many items will be considerable, both of construction and rolling stock.

To compare the cost of the two gauges, separate alignments should be taken, as a considerable saving may be effected in the earthworks by means of sharper curves. If the rigid wheel of the engine admits of a 5-chain curve on the 5 ft. 6 ins. gauge, the same wheel-base will admit of a 3-chain curve on the metre gauge, and in a rough country this smaller radius of curve may be the means of saving a considerable sum.

It may be interesting to state that the cheapest standard-gauge railway in India has cost per mile, for construction and equipment, Rs.52,612, and the cheapest metre-gauge line, Rs.20,045 ; but comparing like with like, the difference in cost is put down, by local authorities, at Rs.15,000 per mile. The following table gives the details of the cheapest standard- and metre-gauge branches in India ; but the standard line, being worked by the main-line company, has only a nominal amount for rolling stock, and was probably constructed with second-hand rails.

			Hyderabad Umarkot.	Jodhpore branch.
Gauge .. .. .. ..	feet.	5 6	3 33	
Weight of rail per lineal yard .. ..	lbs.	60	40	
Miles open .. .. ..	miles	59	321	
Preliminary expenses .. .. ..	£	44	9	
Land .. .. .. ..	"	27	0.4	
Formation .. .. .. ..	"	164	51	
Bridgework .. .. .. ..	"	333	50	
Fencing .. .. .. ..	"	23	1.3	
Ballast and permanent way .. .. ..	"	1036	976	
Stations and buildings .. .. ..	"	175	80	
Plant .. .. .. ..	"	24	11	
Rolling stock .. .. .. ..	"	9	225	
General charges .. .. .. ..	"	866	20	
Total cost per mile .. .. .. ..	"	2701	1424	
Exchange value of rupee taken at per £		14	14	

As bearing upon this point, it may be mentioned that the Baroda Darbar have asked for an extension on the standard gauge to Jainbusar, but the officers of the Bombay, Baroda, and Central India Railway Company do not consider that the prospects of traffic

warrant them in recommending a standard-gauge line for this extension, which, if constructed, should, they consider, be on the 2 ft. 6 ins. gauge. The Gaekwai's Government, also, having revived the proposal for the construction of an extension from Visnagar to Vijapur, estimates for the different gauges have been prepared and submitted as follows, for the 17 miles :—

	£	£
Standard gauge	...	...
Metre	" ..	" ..
2 ft. 6 ins. "	" ..	" ..

A discussion on the working of the standard- and metre-gauge railways took place in the Institution of Civil Engineers, in 1889, when it was clearly proved, that the cost of transport on the metre gauge was as economical as on the standard gauge, under equal circumstances ; and it may be instructive to compare the working of two lines, having practically, the same amount of traffic per mile, the same mileage, and equally favoured in gradients ; one line on the standard and the other on the metre gauge. (See following table) :—

## WORKING EXPENSES COMPARED.

			NAME AND GAUGE OF RAILWAY.	
			Indian Midland.	Bengal and North Western. 3 ft. 3½ ins.
Miles open .. .. .. .. ..			735	756
Cost per mile .. .. .. .. ..	£	8949	5016	
Receipts per mile—passengers .. .. .. .. ..	"	183	191	
" goods .. .. .. .. ..	"	244	237	
" sundries .. .. .. .. ..	"	20	1	
Gross earnings .. .. per mile .. .. .. .. ..	"	447	429	
Working expenses .. .. .. .. ..	"	284	181	
Gross earnings .. .. per train mile .. .. .. .. ..	s. d.	4 7	4 0	
Working expenses .. .. .. .. ..	"	2 11	1 8	
Working expenses of gross earnings .. .. .. .. ..	per cent.	62·72	43·20	
Net return on capital .. .. .. .. ..	"	1·95	5·65	
Maintenance .. .. .. per train mile .. .. .. .. ..	pence	8·0	5·0	
Locomotive power .. .. .. .. ..	"	10·72	4·8	
Repairs, etc., of carriages and waggons .. .. .. .. ..	"	2·72	1·2	
Traffic charges .. .. .. .. ..	"	5·12	4·0	
General charges .. .. .. .. ..	"	5·12	4·0	
Other charges .. .. .. .. ..	"	3·0	1·0	
Passengers carried .. .. per annum .. .. .. .. ..	total No.	1,762,625	5,073,323	
Tonnage of goods .. .. .. .. ..	" tons	555,698	698,809	
Passengers carried .. .. one mile .. .. .. .. ..	" No.	119,385,838	177,907,946	
Goods carried .. .. .. .. ..	" tons	78,221,695	88,388,326	
Train mileage per annum per mile .. .. .. .. ..	train miles	1,950	2,145	
Average cost of coal per ton .. .. .. .. ..	Rs.	8·62	6·97	
Cost .. .. .. per train mile .. .. .. .. ..	As.	3·85	1·54	
Consumption .. .. .. .. ..	lbs.	50·14	30·86	
Consumption per 1000 gross ton miles .. .. .. .. ..	"	161·50	152·61	
Average number of passengers in a passenger train .. .. .. .. ..	No.	175·24	247·66	
Average distance travelled by a passenger .. .. .. .. ..	miles	67·73	35·07	
" No. of tons in a goods train .. .. .. .. ..	tons	100·85	96·80	
" distance over which a ton of goods was hauled .. .. .. .. ..	miles	140·01	127·40	
Average No. of vehicles in a passenger train .. .. .. .. ..	No.	11	16	
" " " goods train .. .. .. .. ..	"	28	32	
" " " in each mixed train .. .. .. .. ..	"			
" " " passenger .. .. .. .. ..	"	9	12	
" " " goods .. .. .. .. ..	"	13	11	
Average cost of hauling one mile—				
One passenger unit .. .. .. .. ..	Pies	1·62	0·78	
One ton of goods .. .. .. .. ..	"	4·44	2·48	
Average sum received for carrying one mile—				
One passenger unit .. .. .. .. ..	"	2·87	2·10	
One ton of goods .. .. .. .. ..	"	6·76	5·62	
Average No. of passengers per vehicle .. .. .. .. ..	No.	17	15	
" " tons per waggon .. .. .. .. ..	tons	3·60	3·0	

One of the most successful of the special-gauge railways in India, running through an ordinary district, is the **Morvi Railway**, of 2 ft. 6 ins. gauge, laid with 30-lb. rails. It is of special interest at this moment, on account of the renewed feeling prevailing in this country for the construction of light railways in agricultural districts. In the Morvi Railway we have a type of the smallest railway that should be put down for steam traction and passenger traffic, except in very exceptional circumstances, but one which is capable of doing a considerable amount of work in a cheap and expeditious manner.

The main line runs from the termini of the broad and metre-gauge railways at Wadhwan, to Morvi, *via* Vaukaner, a distance of 68½ miles, with a branch from Vaukaner to Rajkot of 25½ miles, again joining the metre-gauge system at this point. The line is laid for 24 miles of its length along a bridged and metalled road, and for the remainder along an unbridged and unmetalled one. It is a fairly level surface line, with easy gradients, the maximum being 1 in 150, and curves varying from 250 to 600 feet radius.

The cost of the railway, including construction and equipment, amounts to £1709 per mile. Up to the end of 1886, when the line was 68 miles long, and was laid with 19-lb. rails and patent steel sleepers, the capital cost per mile was only 13,500 rupees, or, say, £1075 per mile. The details of the cost of construction and equipment are as under, per mile—

	£
Preliminary expenses	14
Land	1
Formation, bridgework, and fencing	520
Ballast and permanent way	762
Stations and buildings	30
Plant	12
Rolling stock	278
General charges	92
Total per mile	£1709

The earnings of this railway amount to £22,500 or £240 per mile (£1 = 17 rupees) per annum, and the working expenses to £156 per mile, leaving a net return on capital of 5 per cent.

In connection with a proposed redistribution of the proprietorship of the railways in Kathiawar, proposals were submitted to the local

PLATE XXX.



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TRAIN ON THE TEZPORE RAILWAY. GAUGE 2 FT. 6 IN

(To face p. 204.



Government for the eventual conversion of the 2 ft. 6 ins. gauge to the metre gauge. As the present line runs along the Rajkot road, it is considered that, if the line is changed to a broader gauge, it must be put off the road. Orders have accordingly been issued for an entirely new alignment, to run as direct as possible from Wadhwan to Than, and to completely avoid the Bhagavo river.

The locomotives are four-wheel coupled, with a four-wheel bogie in front, and a six-wheel tender behind (Fig. 7, page 55, and Plate I.). They have 9 ins. cylinders, 16 ins. stroke, and a rigid wheel-base of 6 ft. 2 ins.; the driving wheels are 39 ins. diameter, and the wheels of the tender 24 ins. diameter. The engine weighs  $12\frac{3}{4}$  tons empty, and 15 tons in working order; the tender weighs 5 tons empty, and 10 tons full; the tanks have a capacity of 850 gallons of water, and the coal-box of 80 cubic feet. As in one case there is a run of 50 miles without a stop, the water and fuel is of ample supply, and the oil-cups are designed for sufficient lubrication. These engines have only recently been sent out, and give every satisfaction.

The locomotive superintendent reports that they have run over 51,000 miles each, or an average of 2769 miles per month; while the coal consumption per engine mile, including lighting up, is only 12.5 lbs., and the working expenses (not including supervision)  $3\frac{1}{2}d.$  per engine mile, or 30s. per day.

The passenger carriages are composite, first and second class, on bogies, carrying 10 first- and 22 second-class passengers. They are 24 ft. 3 ins. long  $\times$  6 ft. 3 ins. wide, outside dimensions, with wheels 22 ins. diameter. The net weight of the carriage is 3 tons 18 cwts., or 273 lbs. per passenger. The third-class carriages are open, 23 ft. 7 ins.  $\times$  6 ft. 3 ins., carrying 32 passengers, and weighing 3 tons 5 cwts., or 227 lbs. per passenger.

The general goods wagon is 12 ft. long  $\times$  5 ft. 6 ins. wide, weighs  $1\frac{1}{2}$  tons and carries 5 tons. The high-sided goods wagon is of the same build, weighs  $1\frac{3}{4}$  tons, and carries 5 tons. The covered goods wagon is also of similar build, weighs  $2\frac{1}{4}$  tons, and carries 5 tons.

The goods trains are usually made up of 1 locomotive and 24 waggons, so that the total weight of the train may be taken at 130

tons gross (the waggons not being fully loaded), exclusive of the weight of the engine. The speed attained with this load is from 15 to 20 miles an hour, and the consumption of coal under these conditions is 15 lbs. per train mile, including lighting up. The passenger trains consist of 18 vehicles, and are run at an average speed of 25 miles an hour. A post-office van travels with these trains (Plate XXX.).

**Bengal and Nagpur Railway.**\*—This railway from Nagpur, for a distance of 145 miles, was originally laid on a metre gauge, but, when a shorter communication was required between Bombay and Calcutta, this portion was converted, and the remainder laid on the standard gauge. Additional land was required, cuttings and embankments had to be widened, and where the existing curves were too sharp for the wider gauge, deviations were made. The old station yards were also extended, and the total amount of earthwork done in conversion was 1,404,312 cubic yards, equal to 9685 cubic yards per mile.

All girders above 3 ft. span were replaced by stronger ones, necessitating corresponding masonry alterations; the wing walls, face walls, or parapets of the bridges were altered or raised in consequence of the embankments being widened. New bridges were required in deviations, but a far greater quantity of work had to be done in consequence of the unsatisfactory condition of many of the abutments and wing walls, through badly designed foundations, inferior materials, and bad workmanship. Additional waterways were also provided, where experience proved them necessary.

The deviations from the metre-gauge alignment amounted to nearly  $2\frac{1}{2}$  miles.

The additional quantity of ballast provided was 362,156 cubic yards, equal to a cost of £217 per mile.

The metre gauge line was laid throughout with 40-lb. rails on wooden sleepers, 6 ft. long, while the new permanent way consisted of 75-lb. flat-bottom rails on steel sleepers, weighing 120 lbs. each. New passenger and goods platforms had to be provided at the stations, goods sheds had to be dismantled and re-erected, and new road approaches made to most of the goods platforms. Other minor alterations had to be made, such as raising water-tanks, providing

\* *Min. Proc. Inst. C.E.*, vol. cii.

larger turntables, etc., and large extensions to the workshops on account of the extension of the railway.

The actual capital cost of the railway as taken over by the company before conversion was Rs.80,309 per mile, and adding to this Rs.38,752, the net cost of conversion, after allowing for the value of the old materials, the total cost of the new line was Rs.1,18,786 per mile.

The following is the abstract of the cost of conversion of the 145½ miles :—

Head.	Total expenditure.	Probable credits for metre-gauge materials.	Net expenditure on conversion.
Land .. ..	Rs. 32,297	Rs. nil	Rs. 32,297
Earthwork .. ..	2,58,362	10,000	2,48,362
Bridgework .. ..	10,45,712	2,12,265	8,33,447*
Ballast .. ..	4,12,032	nil	4,12,032
Permanent way .. ..	37,64,253	8,28,156	29,36,097†
Stations .. ..	83,045	1,000	82,045
Station machinery .. ..	1,48,027	35,195	1,12,832
Engine-sheds .. ..	79,403	nil	79,403
Rolling stock .. ..	16,64,530	9,66,392	6,98,138‡
Tools and plant .. ..	65,532	nil	65,532
Establishment .. ..	1,38,316	nil	1,38,316§
Total in rupees .. ..	76,91,509	20,53,008	56,38,501
„ sterling .. ..	£553,803	£157,923	£395,880
Cost per mile of conversion .. ..	.. .. ..	Rs.38,752	
Or „ „ „ .. ..	.. .. ..	£2,721	

From the figures quoted previously, it will be seen that the original cost of the railway (taking the rupee at 20*d.*), was £6666 per mile; deducting £666 per mile for rolling stock, we have, as the cost of construction, £6000 per mile. The *total* amount paid for conversion, without rolling stock, but with a heavier permanent way,

\* In cases of bridges rebuilt, or of which the waterway was increased, a portion only of the expenditure, equal to the cost of conversion, has been included.

† The probable credit for metre-gauge materials appears small, but the wooden sleepers were almost of no value, a large proportion of the fastenings were broken, and the sale price of the rails is only 75 per cent. of the present cost price.

‡ The probable credit for metre-gauge rolling stock seems rather high, but it must be noted that all stock was put into thorough repair before sale.

§ Includes portion of charges for "direction."

was £3000 per mile, or 50 per cent. more than the original narrow-gauge line cost.

It may be said that a narrow-gauge line, capable of carrying more traffic than was forthcoming, was constructed for £6000 per mile, whilst the standard-gauge line (on the same alignment, but with easier curves), to carry the main-line rolling stock and engines, cost £9000 per mile.

Taking the figures in the table above, we may compare the extra cost of a standard-gauge railway and a metre-gauge one, practically on the same alignment (neglecting the permanent way as an item, which will cost more or less, according to the weight of the rail), as exemplified in the conversion of this railway, at per mile.

								£
Land	increase	...	...	...	...	...	...	17
Earthwork	"	...	...	...	...	...	...	142
Bridgework	"	...	...	...	...	...	...	528
Ballast	"	...	...	...	...	...	...	217
Stations and buildings	"	...	...	...	...	...	...	160
Rolling stock	"	...	...	...	...	...	...	100
Tools and plant	"	...	...	...	...	...	...	34
Total extra cost of the broad gauge over the metre gauge, } without permanent way								£1198

The items for land and earthwork represent fairly accurately the amount of difference between the two gauges; but on this railway there was a tunnel which had been excavated, in the first instance, wide enough for the standard gauge, and consequently has not come into the item for earthwork, otherwise this item would have been considerably increased for the standard gauge. The item for bridgework is large, though Note ‡ explains that the expenditure equal to the cost of conversion only, has been included.

The stations and buildings should be little affected by the gauge; but in this instance the goods platforms had to be raised, and new approaches made, and new passenger platforms built, on account of the increased height of the main-line railway stock. Several sundry other details required attention, and those who put the difference in cost between a standard-gauge and narrow-gauge railway, comparing *like with like, in an easy country*, at £750 per mile, due to the gauge, are probably correct.

Extra expense would be incurred by having to keep the traffic going on the metre-gauge line during the laying of the new permanent way ; but this would be more than counterbalanced by the facilities which the narrow gauge would give in transporting and laying out the broad-gauge materials.

*Extension of Railways in India.*

To encourage railway extensions in India, the Government of India issued a circular from Simla, dated September 15, 1893, and a further one from Calcutta, dated March 29, 1895, setting out the terms on which the Government of India are prepared to consider offers for the construction, by the agency of private companies, of branch lines or extensions of existing railways, to be worked, when constructed, by the main-line administrations.

Before giving the details of these circulars, it may be well to refer to Sir Andrew Clarke's \* reply to the address of the Agents of the Guaranteed Railway Companies of India (presented to him on his retirement), which appeared in the columns of the *Indian Engineer*. Sir Andrew wrote—

“ Representing as you do, the collective interests of the large body of English capitalists who have contributed a hundred millions sterling towards the material advancement of India, I attach especial value to the testimony you bear, to the improved relations that now exist between the representatives of this important interest and the Government. To you . . . is really mainly due the present condition of these relations. Confidence begets confidence, and I cannot but think that whilst, on the one hand, the appreciation of my desire to comply with all your reasonable applications has of itself smoothed away difficulties of intercourse; on the other hand, the knowledge you have acquired of my reliance upon the general accuracy of your anticipations of the growth of traffic, has had the result of inducing still greater caution and care in the framing of your estimates, and of causing you to put forward only well-considered proposals.

“ In the interests of the public, as well as of private commercial enterprise, I would fain hope for a continuance of these improved relations. The aid and co-operation tendered by the railways under your management, during the crisis engendered of famine and war, have assured me of their perfect efficiency under such control and management, and that no advantage is to be gained by placing them entirely in the hands of the State, as has been the tendency of our policy for the last few years. Firmly convinced as I am that the development of the country's resources by encouragement to private enterprise is in every way more desirable than a universal reliance on direct agency of the State alone, I consider the experience

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\* Late Director-General of Railways in India.

already acquired on our railways as of infinite value in determining our future policy regarding them. It seems to me, however, by no means improbable, that a time may come, if it has not come already, when adverse influences upon the public finances may seriously check the extension of our railway system exclusively by the State, and that their attention will, not unnaturally, be again directed to the propriety of substituting for it agencies somewhat similar to those which you represent."

This reply was written in 1880, and to-day the prophecy contained in the latter part of his letter has come true. During this year two railways in India have been projected by private companies, under a guarantee from the State railways, viz. the South Behar and the Southern Punjab Railways.

**The South Behar Railway** is on the 5 ft. 6 ins. gauge, 83 miles long, and estimated to cost £7230 per mile without rolling stock.

The prospectus of the company contains, amongst others, the following clauses :—

"The railway will, as the various sections are completed, be worked by the East Indian Railway Company, who will supply the requisite rolling stock, and maintain and work the line in consideration of receiving 45 per cent. of the gross receipts. Provision is made by the Government . . . for a rebate to this company of a sum not exceeding 30 per cent. of the gross earnings of the East Indian Railway from traffic, interchanged between the new line and the East Indian Railway, so long as the company does not otherwise receive a minimum return, after deducting the cost of working and maintenance, of 4 per cent. on the capital expenditure, as entered in the books in India. This arrangement has been adopted owing to the policy of the Government in ceasing to give specific guarantees of interest.

"The whole of the net earnings beyond 4 per cent. will in every case belong exclusively to the shareholders.

"The terms arranged between the Government and the company for carrying out this undertaking are as follows :—

"1. The Secretary of State sanctions the payment by the company out of capital, of interest during construction, until the close of the half-year next following the half-year in which the line shall have been opened throughout for public traffic, or until June 30, 1899 (whichever shall be the earlier date), at a rate not exceeding 4 per cent. per annum.

"2. The company will have the free use of such land as is necessary, in the opinion of the Government of India, for the construction of the railway, and for the stations, station yards, offices, warehouses, houses for employees, conveniences, and works necessary or proper for the purposes of the railway, as well as for quarrying, ballast, brickfield, and kindred purposes.

"3. The railway will be maintained and worked by the East Indian Railway Company, under contract between the Secretary of State and that company for the purpose, in return for 45 per cent. of the gross earnings from all sources. This payment will include charges for the use of the necessary rolling stock. After the

opening of the line, charges for home management expenses of the company will have to be defrayed out of its share of gross earnings.

“4. A return will be made to this company, by the East Indian Railway, of such a sum from the receipts from the traffic interchanged between that railway and the new railway as shall, together with this company's share of the earnings of its own line, and of the proportion of through traffic from Gya to Lak-Nisarai assigned to it, be sufficient to give this company 4 per cent. per annum on the actual expenditure charged in the capital account of the company's railway, as entered in the company's books in India, at the close of each half-year; provided always that the return so made to the company shall not exceed 30 per cent. of the share of the East Indian Railway of receipts from traffic interchanged between the two systems, nor shall be payable on any sum exceeding a maximum capital of Rs.1,20,00,000 = about £700,000. (The East Indian Railway Company have agreed that the charges for through traffic shall be allocated on the assumption that it has been sent over the shortest route, except in cases where the saving in mileage between the alternative routes is less than 5 miles, and except where passengers or consignors shall elect to travel or send their goods by the longer route, and to assign to this company a fixed proportion of the receipts therefrom.)

“5. The Secretary of State reserves the right of taking over the line on the 30th June, 1919, or on the 30th June in the last year of every subsequent period of 10 years, on giving the company 12 months' previous notice of his intention to do so, and paying to the company in England, in sterling, such a sum as shall, when added to any unspent capital, amount to the total paid-up capital, in sterling, so far as such capital (exclusive of unspent capital) shall have been expended on the undertaking, with the authority of the Secretary of State.

“6. The line will be constructed on the 5 ft. 6 ins. gauge, equal to the standard of the East Indian Railway, and will be maintained by the company in good order for 24 months, from the date of the opening of any section for public traffic.

“7. The company engages to provide the needful funds for the purposes of construction and maintenance of each section as opened, for two years, and thereafter for additions to block (as distinguished from rolling stock), which may be necessitated by public requirements and traffic development, also to construct such extensions as may be agreed upon by the company and the Secretary of State, and to meet any further expenditure as shall be properly chargeable to capital.”

**The Southern Punjab Railway Company** has the following clauses, amongst others, in its prospectus:—

“The Company will construct, under a contract with the Secretary of State for India, a railway on the Indian standard gauge from Delhi to Samasata, on the North-Western State Railway, a distance of 400 miles.

“The cost of the line will be exceptionally low. It will traverse a flat, unbroken country, the expense of bridges will be small (17 lineal feet per mile), and there are no engineering difficulties of any kind. According to the surveys and estimates recently prepared and submitted by its engineers to the Government of India, the estimated cost of construction per mile was £4044 (exchange being taken at 1 rupee = 1s. 2d.). From this have to be deducted the cost of rolling stock, which will be met by the North-Western State Railway, and other items, such as the cost of land and surveys, and also certain savings on construction that can be effected. Adding

interest during construction, and other charges, including maintenance for twelve months after opening, the total estimated cost of the line is £3664 per mile.

" The principal terms of the agreements with the Secretary of State for India are briefly as follows:—

" 1. Payment out of capital by the company, during construction, of interest calculated at £3 10s. per cent. on the capital of the company, including the debenture capital.

" 2. The working and maintenance of the line, and the supply of the necessary rolling stock by the Secretary of State through the North-Western State Railway, for 52 per cent. of the gross earnings. The North-Western State Railway is worked by, and is the property of, the Government of India.

" 3. The payment of a rebate to the Southern Punjab Railway of such a sum as will, together with the net earnings from traffic, and other receipts of that railway, provide a rate of interest not exceeding 3½ per cent. per annum, on the capital expenditure of that railway, as shown in the accounts in India. As these accounts are kept, all sums expended as capital are entered at the rate of exchange current at the time of the expenditure, and the total of the entries constitutes the capital expenditure for the purpose of calculating the rebate.

" The rebate shall not exceed the net earnings, as defined in the contract, of the North-Western State Railway (1) from all traffic originating and terminating at stations of the North-Western State Railway (including Delhi and Samasata) sent over the Southern Punjab Railway, and (2) from the proper share attributable to the North-Western State Railway of the traffic interchanged between the Southern Punjab Railway and the North-Western State Railway.

" 4. When £3 15s. per cent. on the total capital expenditure of the company has been earned, the equal division of the surplus profits between the company and the Secretary of State for India.

" 5. The use of land in British territories, and surveys and reports, free of cost, the Secretary of State engaging to use his influence to acquire land in native States required for the company on the same terms.

" 6. Special low rates for the carriage of materials for construction over State railways.

" 7. The gross earnings of the Company's line to consist of—

“(a) Gross earnings from its local or home traffic.

“(b) Its mileage proportion of traffic interchanged between the North-Western State railway system.

“(c) Its mileage proportion of traffic interchanged between the North-Western State Railway system and other railways, in all cases in which the company's line forms part of the shortest route, whether such traffic passes over the company's line or not.

" The charges for traffic of all kinds to be on the mileage of the shortest route, and when shared, to be shared proportionately on the respective mileages.

" The charges to be governed by the rates and fares of the North-Western State Railway.

" 8. The gross earnings from traffic originating and terminating at stations, including Delhi and Samasata, on the North-Western State Railway, to belong to the North-Western State Railway.

" 9. The right of the Secretary of State to purchase the company's line at the expiration of 21 years from the date fixed for completion of the line, and thereafter at successive intervals of 10 years, at 25 years' purchase, based on the company's

share of the average net earnings of the line for the 5 years immediately preceding the purchase; provided the price shall not in any case exceed the total capital expended in sterling, with the sanction of the Secretary of State for India (including the dehenture capital so expended), by more than 20 per cent. on that capital, and shall not be less than the sterling capital expenditure. The net earnings will not include any payments made by way of rebate, nor the share of the surplus profits taken by the Secretary of State. The Secretary of State will have the right to purchase at a price equal to the capital expenditure, but not till the 31st December, 1948. The Secretary of State reserves the right of determining the contract if the line is not completed, and ready and fit to open for traffic, by the 31st December, 1898, unless he shall be satisfied there has been no neglect or default by the company, and in the event of its being so determined, the Secretary of State will pay the fair value of the company's railway and works, to be ascertained, in case of difference, by arbitration.

"10. The Secretary of State accepts no responsibility for the estimates of the cost of the proposed undertaking or its probable profits after completion."

Another railway, but of a different type, brought out this year, is the **Barsi Light Railway**. This line joins the Great Indian Peninsular Railway at the Barsi Road Station, and is intended to run to the town of Barsi, a distance of nearly 22 miles, and to be further extended as required.

The following clauses, amongst others, appear in the prospectus:—

"The gauge adopted is 2 ft. 6 ins., which, after the fullest consideration and examination, has been deemed most suitable for the traffic and the character of the country to be traversed, with respect to extensions both in the direction of Pandharpur and beyond Barsi, which the successful working of the new line will necessitate, and its great carrying capacity in comparison with the low cost of construction per mile, and economy of working, and the flexibility of its alignment, which enables it to utilize existing roads, have also had great weight in deciding the question.

"The line from Barsi Road Station to Barsi is nearly twenty-two miles in length, and will be laid on the existing provincial road. This road, with its earthworks, cuttings, and bridges, was constructed by the Government of Bombay, in 1870, for the purpose of a light railway, with maximum gradients not exceeding 1 in 100, and with curves suitable for the alignment of a railway. The bridges have been built of sufficient strength to carry locomotives, and have stood the test of floods for twenty-five years; the earthworks, too, are thoroughly consolidated.

"Calculated upon an estimated annual goods traffic of 70,000 tons, which appears reasonable, the receipts from goods, on the basis of the rates and terminals sanctioned, would amount to Rs.2,29,767, and from an average of 62,731 passengers annually (excluding pilgrims), even if taken at the lowest rates sanctioned, would amount to Rs.21,563, or an average gross total of Rs.2,51,330, equal, at exchange of even, say, 1s. per rupee, or 9 per cent. below the current rate, to £12,566 10s.

"The average percentage of working expenses to gross earnings of all railways of 2 ft. 6 ins. and 2 ft. gauge in India, as shown in the official administration report on the railways in India, for 1893-94, is 55·40 per cent., based on a much smaller traffic than that which the Barsi Railway is likely to receive.

"Subject to the provisions of the Indian Railway Act, 1894, the Secretary of State

sanctions the payment out of capital of interest, at the rate of 4 per cent., during the original construction of the railway; but the Secretary of State, in granting this authorization, does so on the understanding that he does not thereby incur any responsibility for the estimates of the railway, or its probable profits after completion.

“The concession confers on the company an exclusive right, as carriers by railway, over the tract traversed by their line.

“Subject to the duty of keeping the roads in repair, and reconstructing an old municipal road—for which purpose the company is to be at liberty, free of charge, to take road metal and material from Government quarries—the company has the right to use, for the purpose of constructing its railway, a sufficient portion of the provincial road, and the whole of the Barsi municipal road.

“The tolls leviable under Bombay Act III., of 1875, on the ordinary traffic on the provincial road above referred to, are to be placed under the management of the company, and the company is to be entitled to appropriate such tolls.

“The Secretary of State reserves the right (on giving to the company in England, not less than twelve calendar months' previous notice of his intention to do so) of determining the concession, and purchasing the undertaking of the company, either on the 1st day of January 1917, or at the expiration of any subsequent period of ten years, on paying to the company in England, in sterling, such a sum as, with any unspent capital, shall amount to the total amount of the paid-up capital, in sterling, so far as such capital (other than unspent capital) shall have been expended on the undertaking with the authority of the Secretary of State.”

No assistance in the shape of a rebate is given to this company, but the value of the road handed over by the Government for the purposes of the railway is estimated at £30,000, or £1300 per mile.

The rebate proposed in the circular previously referred to, issued by the Government of India, was only 10 per cent. on the interchanged traffic between the main and the branch lines; but it will be noticed that, in the case of the South Behar Railway, the rebate allowed is 30 per cent. This alteration was probably due to the action taken by the London Chamber of Commerce, the secretary of which body wrote to the Secretary of State for India—

“that the above section of this Chamber (the Engineering and Allied Trades Section) was of opinion that the proposed maximum rebate of 10 per cent. on the interchanged traffic between the main and branch lines was neither a fair division of the profits of such interchanged traffic nor a sufficient inducement to capitalists to invest in Indian railways.”

Speaking at the same meeting on the above subject, Sir Andrew Clarke said that:—

“this question interested him considerably, as he was chairman of the first Indian Branch Company which was formed in London, and worked by the main line. Up to the present, although the success of the line had been very good, yet the arrangements with the Government of India had not been satisfactory, and he inferred from this that, unless the subsidiary lines were to a certain extent made identical with

the working lines, their success would not be assured. While engineers understood, more or less, what the 'rebate' meant, the English investing public did not. His object in coming there that day, was to suggest that the old word, 'guarantee,' should be substituted for the word 'rebate.'

"The guarantee system had been greatly conducive to the prosperity of the railway system and people of India. He had had some experience of the working of that system, and he had no hesitation in saying that the administration of the guarantees had been extraordinarily successful . . . He found the guarantee system much more elastic than the State lines. He came there anxious to support private enterprise in railways in India. . . . The two practical points regarding which it was desirable to approach the Government were, first, to get rid of the 'rebate'—do not go to the public with the word 'rebate,' they do not understand it; let us return to the old guarantee system.

"Secondly, what is the minimum we can go to the public with? He thought he would be absolutely safe—that the parent companies would be safe—in saying  $3\frac{1}{2}$  per cent. He believed that rate would attract capital to Indian railways, especially if the first lines were made feeder lines to the great system . . . we might confine ourselves to the great feeder lines, leaving other lines to be developed."

**Terms put forward by the Government of India for the Extension of Railways by Private Enterprise, and Proposed Amendments.**

These were considered at the annual meeting of the Engineering and Allied Trades Section of the London Chamber of Commerce; and at an adjourned meeting in June, 1895, Mr. Duff-Bruce brought forward amendments which were supported by Sir Andrew Clarke, and finally adopted by the meeting.

The amendments proposed are printed in *italics*.

The concessions offered are—

- "1. The free use of land.
- "2. The provision of rolling stock, and the maintenance and working of the new lines at favourable rates by the main-line administrations.
- "3. The free use of surveys, etc., at State expense.
- "4. The carriage of stores and materials over State lines at favourable rates.
- "5. The grant of a limited rebate, from the main-line earnings, towards ensuring the proprietors of the new lines a dividend of 4 per cent. per annum on the approved capital expenditure (or  $3\frac{1}{2}$  per cent., if the capital is reckoned in rupees).
- "6. If it can be legally arranged, authority will be given to charge to the capital account of the branch railway, during construction, and until the close of the half-year next following the half-year in which the branch railway may be fully opened for traffic, such sum as, together with any net receipts from working, will suffice to pay interest at the rate of 4 per cent. per annum on the paid-up capital.

*"Resolution.*

*"Proposals for the construction of branch lines or extensions of existing railways, made by persons who satisfy the Government that*

*they are in a position to command substantial financial support, will be considered on the undermentioned terms and conditions, viz. :—*

“1. The proposed railway (hereinafter called ‘the branch railway’) must be built in accordance with the fixed and moving dimensions for the time being prescribed by the Governor-General in Council, and on plans and estimates that have been approved by that authority.

“2. The extent and details of the concessions to be granted in each case will be settled by agreement, *but the company will be allowed to debit to capital such reasonable amount as may be found necessary to cover the preliminary expenses, and obtain the necessary capital.*

#### LINES TO BE CONNECTED WITH STATE RAILWAYS.

The following terms will apply to projects for the construction of branch railways to be connected with State railways—

“3. Access will be given on application, and free of charge, to all information, plans, or estimates in the possession of Government that relate to railways whose construction the Government is prepared to entrust to companies; but no responsibility will be accepted by Government for the accuracy of any information, plan, or estimate thus made available.

“4. The use of such land as is necessary, in the opinion of the Government of India, for the construction of the branch railway, and for the stations, station yards, offices, warehouses, houses for employees, conveniences, and works necessary or proper for the purposes of the railway, as well as for quarrying, ballast, brickfields, and kindred purposes, will be provided by Government free of charge.

“A. Where application is made for a concession for a project which has not been surveyed, or the construction of which has not been approved by the Government of India, the applicants will be required to deposit the cost of the surveys, estimates, and collection of statistics necessary for the proper consideration of the project, as a condition preliminary to the acceptance for consideration of their proposals. In the event of the construction of the project being sanctioned, the costs incurred on this account will be admitted on capital account.”

The cost will depend on the difficulty of the route, and will vary from Rs.250 per mile in very easy country, to Rs.500 in ordinary country, not including Ghat surveys.

“B. Provision will be made for including in the approved expenditure of the branch line railway company such expenses on account of the Board of Directors of the company as may be incurred, with the sanction of the Secretary of State.

“(a) During the construction of the branch line, these expenses of direction may be charged to the capital account of the branch line company.

“(b) After the opening for public traffic of the branch railway, these expenses of direction will be met from the general receipts of the branch line company.

“5. The branch railway will be maintained and worked by the main-line administration during the full currency of the contract to be entered into for the

purpose, at a fixed ratio of expenses to earnings, in each half-year. The ratio will, when the branch railway is of the same gauge as that of the working railway, usually be that obtaining on the whole system, including the branch railway, and will not ordinarily exceed 50 per cent. of the gross earnings of the branch from all sources, and will be inclusive of charges for the use of the main-line rolling stock. Charges for Home Board direction of the branch railway will be excluded from the arrangement, and will have to be defrayed out of the share of the earnings pertaining to the branch railway.

*“After the words ‘main-line rolling stock,’ substitute, ‘but no deduction whatever will be made for working expenses until the gross receipts of the line from all sources are sufficient to pay 3½ per cent. on the whole capital of the company, whether raised by shares or debentures, after providing a sum to be sanctioned by the Secretary of State for charges for Indian and London management. After the payment of 3½ per cent. on the capital and the full working expenses, the balance of the net earnings to be divided in the proportion of two-thirds to the owning company, and one-third to the working company.’”*

“6. Railway materials for the branch railway will be carried over State lines at the special rates prescribed for such materials belonging to State railways.

“7. A return will be made to the branch line, by the main line, of such a sum from the traffic interchanged with it as shall out of the gross earnings of the main line, together with the branch company’s share of branch earnings, be sufficient to give the branch company a dividend of 4 per cent. (or if the capital is reckoned in rupees, 3 per cent.) per annum, on the actual expenditure charged in the capital account of the branch railway company, as entered in the company’s books in India; provided always that the return so made to the branch company shall in no case exceed 10 per cent. of the gross earnings of the main line, from traffic interchanged between the main and branch lines. This rebate will be granted from the first earning of revenue by the branch line, such payment being calculated at the close of the calendar year, payments on account, however, subject to adjustment being permissible at the close of the first half of each year.”

NOTE.—The net earnings of the main line from traffic interchanged with it from the branch line are assumed to bear the same proportion to the gross earnings from that traffic as the net earnings of the whole system bear to the gross earnings of the whole system.

*“It is proposed to omit this clause altogether, as it is not required if interest on the capital is made a first charge against the gross receipts.”*

“8. After the opening of the branch railway throughout for public traffic, every new work not costing more than Rs.1000, but otherwise properly chargeable to capital, shall be charged to revenue, and the cost thereof shall be held to be provided for, from the share of the gross receipts paid to the main-line administration.

“Funds for the execution of *all other* new works—properly chargeable to capital—found necessary after the branch railway has been opened to traffic, shall be provided by the branch railway company. Such works, and their cost, must be agreed upon between the branch railway company and the main-line administration, before they are put in hand. In the event of any difference of opinion arising, between the branch-line and the main-line administration, as to the necessity for, and the cost of any new work, the matter will be referred to the Director-General of Railways as arbitrator, and his decision will be final.

“9. Rates and fares upon the branch railway shall be within the limits of the

schedule of maximum and minimum rates that may be from time to time authorized by the Government for the main line, and shall be controlled by the main-line administration. Ordinarily the rates and fares charged on the branch railway shall be not more than the highest, nor less than the lowest, mileage rates charged for the time being, for similar traffic on the main line. Deviations outside of these mileage rate limits will not be permissible, except with the special sanction of Government in each case.

*"In all cases in which the branch railway forms a part of the shortest route between the forwarding and receiving station, it is to be treated as the proper route for traffic.*

" 10. Government will have the right, on giving twelve months' notice, to purchase the branch railway, either—

" A. At the expiration of 21 years from the date of opening to traffic of the branch railway, and thereafter, at successive intervals of 10 years, at 25 years' purchase, based on the average net earnings of the branch for the five years immediately preceding the purchase, provided that the price shall not in any case exceed the total capital expenditure by more than 20 per cent., and shall not be less than the capital expenditure. *Amend this as follows:—*

*" At the expiration of 25 years from the date of opening for traffic of the branch railway, and thereafter at successive intervals of 10 years, at 25 times the average amount paid to the company out of gross earnings for the three years immediately preceding the purchase, provided that—and so on as above. Or—*

" B. At the expiration of 50 years from the date of opening to traffic of the branch railway, on payment of the actual capital expenditure. *This clause to be omitted altogether.*

" C. Provided always that in calculating the purchase price, the average net earnings of the branch shall not include, for the purposes of this clause, the payments by way of rebate under clause 7.

" 11. Electric telegraphs and telegraphic appliances will be supplied and maintained by the Government of India; the charges for rent, maintenance, and inspection of telegraph works and appliances will be included in the working expenses. Free passes shall be granted over the branch railway for persons employed by the Government of India, on the construction, maintenance, working, and inspection of the telegraphs.

" 12. The rates and arrangements in force on State railways in the matter of services rendered to the Postal Department, to the Military, Police, and other Departments of the State, and to high Government officials, shall be applicable to the branch railway.

" 13. The general character of the supervision and control that will be exercised by the Government of India over the branch railway, apart from the provisions of the Railway Acts and the preceding provisions of the Resolution, is indicated in the following paragraphs:—

" 1. The route of the line and the situation of the stations, and other similar details, will be determined by the Government of India.

" The line, while under construction, shall be inspected when, and so often as, an inspecting officer appointed for that purpose by the Government of India, shall consider desirable, with a view to ensure the construction of the line up to the standard agreed on.

" 2. The branch railway company, if required, shall keep capital accounts and

statistics in forms approved by the Secretary of State, and shall render, free of cost, all accounts and statistics required by the Government. The accounts and books will be subject to audit on behalf of the Government.

- “3. No capital expenditure by the branch railway company will be allowed as between the Secretary of State and the company, unless the prior sanction of the Secretary of State has been obtained.
- “4. The company shall have no power to increase its share or stock capital, without the sanction of the Secretary of State, or to borrow money except within a fixed limit, and on specified conditions.

“**LINES TO BE CONNECTED WITH RAILWAYS BELONGING TO, OR WORKED BY, GUARANTEED OR ASSISTED COMPANIES.**

“As regards branch railways connecting with railways belonging, or leased to, guaranteed or assisted companies.

“14. Land necessary, in the opinion of the Government of India, for the purposes of the railway will be provided by Government, free of charge, as indicated in paragraph (4) above.

“15. The terms under which the branch railway will be maintained and worked by the main-line administration will be subject in each case to agreement between the main-line and branch-line companies, and to the approval of the Government. The Government will endeavour to obtain for the branch railway company terms approximating to those that would be granted under the terms of this resolution if the branch railway were connected with a State railway.

“16. Other relevant concessions and stipulations contemplated by this resolution in the case of branch railways connecting with State railways will be applied.

“**ALTERNATIVE TERMS AND SURVEYS.**

“17. The Government of India will be prepared to consider proposals for working branch lines on terms other than the above which may be put forward by promoters.

“18. If, after consideration of the question on its merits, it be decided that the gauge of any branch line shall be different from that of the main line, the question of the ratio of expenses to earnings at which the branch shall be worked, will be subject to arrangement in each case, but in such cases the branch line must be fully supplied with necessary rolling stock, and workshops, by the branch railway company.

“19. When application is made for permission to construct a branch line, which the Government is inclined to entrust to a company, on a route which has not been surveyed, the survey will, if so desired, be carried out by the Public Works Department of the Government of India, on the applicants undertaking to pay the cost of such survey, and depositing the estimated amount thereof, on the understanding that, if permission is eventually given for the construction of the line, the actual cost of the survey may be included in the capital cost of the undertaking.

“Applications for permission to carry out surveys for the construction of branch lines should be submitted to the address of the Secretary to Government of India, Public Works Department, in the form prescribed by Memorandum B hereto attached.”

*Remarks on the above Clauses by Mr. Duff-Bruce.*

“ *Clause 2.* It is of course impossible to lay down in general proposals such as these the exact extent, or the details of the concessions which will be required for each separate railway, but it would be well, in publishing general conditions, to let persons who are desirous of going in for Indian Railways understand that the Secretary of State would allow a reasonable sum to be debited to capital to cover their expenses, and secure the necessary capital, and also that, during construction, interest at the rate of 3½ per cent. will be allowed to be charged to capital. It cannot be expected that any one will take the trouble to get together particulars for the construction of a railway without being compensated, nor can it be expected that capitalists will come forward to guarantee the money required for the construction of the line unless they are allowed commission for accepting the responsibility of finding the money.

“ *Clause 5.* If Clauses 5 and 7 of the Government proposals are read together, it seems clear that it was the intention of the Government that this risk (of providing interest) should be taken by the working company, instead of by the shareholders of the branch line, as it is there provided that the working line shall grant a rebate from the earnings of interchanged traffic sufficient to give a branch company a dividend of 4 per cent. This has been the procedure hitherto adopted in England; but in India it would, it is feared, be found in practice, difficult to work, and while it would secure very large dividends to some branch lines, it would be no advantage whatever to others. For instance, in the case of a branch line which had a lead over the main line very much longer than the length of the branch line, the rebate would amount to a very considerable sum; whereas, in the case of a branch line close to the terminus of the main line, the lead on the main line would not probably be much greater than the length of the branch line, and the rebate allowed in clause 7 might be quite insufficient to make up the amount required to make up the 4 per cent. In every case this arrangement would lead to a very complicated system of accounts, to ascertain the exact amount which was refundable to the branch-line company, and it would be very difficult, in a prospectus, to show shareholders that a rebate on an estimated traffic would be sufficient to make up the minimum dividend of 4 per cent. The object of the rebate is merely to insure that the receipts, after deducting working expenses, are made up to a sum sufficient to give the interest proposed; but this can be equally well done by the (condition) proposed; a condition which has been adopted in an agreement recently made by the South-Western Railway Company for the working of the branch line between Waterloo Station and the City. In that case no absolute guarantee is given, but it is provided that interest at the rate of 3 per cent. per annum on the whole authorized capital, whether it be raised in shares or debentures, shall be a first charge on the gross receipts of the undertaking before any deduction whatever is made for working expenses. When investors can get such terms as these from a railway company in England, it is not probable that they will invest money in India on less favourable terms. Such an arrangement would give great confidence to investors, and it would ensure that the officers of the working company who have the whole management of the line in their hands would do their best to increase the revenue, so as to enable them to meet their own working expenses, after paying a dividend on the capital.”

It is of the utmost importance to the Empire of India that the country should have many more miles of railways, and a calculation

has been made that at least 1000 miles of railway per annum should be constructed to keep pace with the increase of population, if the people are to be fed, and employment found for them, on land that is at present cut off from railway communication. However correct this statement may be, Sir Alexander Rendal estimated the traffic requirements of India at 50,000 to 60,000 miles of railway, yet she has only 18,500 miles.

TABLE

PARTICULARS OF COST, REVENUE, AND WORKING EXPENSES OF THE STANDARD, METRE,  
SPECIAL GAUGE

		All railways on gauges—			East Indian. 6 ft. 6 ins.	Bengal Nagpur. 6 ft. 6 ins.			
		5 ft. 6 ins.	3 ft. 3½ ins.	2 ft. 6 ins.					
Miles open .....	..	miles	10,696	7367	267	1610	862		
Cost per mile, including rolling stock .....	..	£	13,414	5882	2200	14,900	9174		
Receipts per mile—passengers .....	..	..	..	365	214	163	670	103	
"    "    goods .....	..	..	..	741	312	177	1326	357	
"    "    sundries .....	..	..	..	28	20	4	22	39	
Gross earnings .....	..	per mile	..	1134	646	344	2018	499	
Working expenses .....	..	..	..	618	272	190	666	246	
Net earnings .....	..	..	..	616	274	154	1462	254	
Gross earnings .....	..	per train mile	s. d.	5 7	4 2	4 2	6 10	5 7	
Working expenses .....	..	..	..	2 6	2 1	2 3	1 11	2 9	
Net earnings .....	..	..	..	..	3 1	2 1	1 11	4 11	2 10
Working expenses of gross earnings .....	..	per cent.	45·68	51·12	55·40	27·44	49·17		
Net return on capital .....	..	..	..	5·48	5·38	6·63	9·82	3·33	
Maintenance .....	..	per mile	£	137	67	41	118	71	
Locomotive power .....	..	..	..	172	92	59	172	64	
Repair & renewals of waggon & carriages .....	..	..	..	48	21	16	49	19	
Traffic charges .....	..	..	..	85	44	34	118	36	
General charges .....	..	..	..	49	36	32	74	49	
Other charges .....	..	..	..	27	12	8	35	6	
Maintenance .....	..	per train mile	pence	8·0	6·3	5·9	4·8	9·5	
Locomotive power .....	..	..	..	10·0	8·5	8·5	7·0	8·5	
Repair and renewal of waggon, etc. .....	..	..	..	2·8	1·9	2·3	2·0	2·5	
Traffic charges .....	..	..	..	5·0	3·9	4·6	4·8	4·75	
General charges .....	..	..	..	2·8	3·4	4·5	3·0	6·5	
Other charges .....	..	..	..	1·4	1·0	1·2	1·6	0·6	
Passengers carried per annum .....	..	total	No.	88,454,834	46,245,635	819,978	15,892,268	2,198,258	
Tonnage of goods carried per annum .....	..	..	tons	21,242,685	7,484,701	119,343	5,340,692	1,242,641	
Passengers .....	..	per mile	No.	8,446	6,178	3,291	9,864	2,560	
Tonnage of goods .....	..	..	tons	2,028	1,000	479	3,317	1,441	
Train mileage .....	..	..	miles	4,073	2,632	1,663	5,906	1,787	

\* Compiled from Railway Administration Report for year 1893, for standard and  
† Includes compensation.

P.

AND SPECIAL GAUGE RAILWAYS OF INDIA, AND ALSO OF SOME STANDARD, METRE, AND LOCAL RAILWAYS.\*

## NAME AND GAUGE OF RAILWAY.

Indian Midland, 6 ft. 6 ins.	Rajputana Bardia, 6 ft. 6 ins.	Bengal Central, 6 ft. 6 ins.	Hyderabad Umarkot. 6 ft. 6 ins.	Rajputana Malwa, 3 ft. 3½ ins.	Bengal and North- Western. 3 ft. 3½ ins.	Jodhpore Branch, 3 ft. 3½ ins.	Bikaner Branch, 3 ft. 3½ ins.	Jorhat, 2 ft. 0 ins.	Darjeeling, Darbhanga, 2 ft. 0 ins.	Gaekwai Dabhoi, 2 ft. 6 ins.	Morvi, 2 ft. 6 ins.
735	108	125	59	1674	756	320	43	27	51	72	94
8949	4420	6500	2701	6936	5016	1432	1586	2288	4000	2125	1709
183	204	301	82	266	191	85	65	25·6	327·0	117·6	149·8
244	214	114	66	629	237	95	48	145·9	639·8	84·3	86·6
20	4	1	—	2	1	—	1	3·1	11·1	1·3	3·9
447	422	416	148	897	429	180	104	174·6	877·9	203·2	240·3
284	236	248	131	360	181	86	63	170·6	505·7	134·8	155·9
163	186	168	17	637	248	94	41	4·0	372·2	68·4	84·4
4 7	4 10	3 6	2 11	4 7	4 0	3 10	2 9	3 11	6 10	3 7	2 11
2 11	2 9	2 1	2 7	1 10	1 8	1 10	1 8	3 10	3 4	2 4	1 10
1 8	2 1	1 5	0 4	2 9	2 4	2 0	1 1	0 1	2 11	1 3	1 1
62·72	55·00	59·80	87·41	41·12	43·20	47·83	61·43	97·2	67·6	66·3	64·9
1·95	4·58	3·12	0·47	10·15	5·65	6·3	2·66	0·2	8·78	3·81	5·36
85	62	49	62	61	45	28	16	44	110	61	33
87	83	54	33	153	43	33	30	39	176	41	53
23	22	22	11	37	11	4	3	17	54	10	9
43	32	53	14	60	36	10	9	43	69	21	22
42	20	63	8	48	35	7	6	26	78	12	29
24	7	5	3	9	11	4	—	2	19†	—	6
8·0	8·6	5·2	4·8	3·8	5·0	7·2	5·2	11·9	8·8	10·7	4·7
10·72	11·52	6·7	7·8	9·4	4·8	8·5	9·6	10·6	14·2	8·7	7·7
2·72	3·0	2·4	2·5	2·3	1·2	1·1	0·9	4·4	4·3	2·0	1·2
5·12	4·5	5·7	3·2	3·7	4·0	2·6	2·8	11·7	5·5	4·5	3·3
6·12	2·7	5·6	2·0	2·9	4·0	1·6	1·7	7·0	6·2	2·5	4·1
3·0	0·75	0·5	0·7	0·5	1·0	1·6	—	0·4	1·5	—	0·8
1,762,625	767,634	1,621,768	383,982	10,070,473	6,073,323	578,578	65,629	—	—	362,992	—
655,698	166,269	113,516	33,287	1,835,100	693,809	105,345	10,509	—	—	46,533	—
2,398	7,108	12,974	6,508	6,016	6,711	1,808	1,526	2059	1069	6,041	2387
756	1,539	908	564	1,096	917	329	244	—	—	646	—
1,950	1,722	2,265	1,016	3,914	2,145	939	756	884	2987	1,134	1655

metre gauge lines, and from Railway Reports for year 1891, for special gauges.

DETAILS OF COST OF CONSTRUCTION AND EQUIPMENT OF SOME STANDARD, METRE, AND SPECIAL GAUGE LOCAL RAILWAYS OF INDIA.

TABLE Q.

NAME AND GAUGE OF RAILWAY.										
	Hyderabad Umrikot. 5 ft. 6 ins.	Rajpura Bhatinda. 6 ft. 6 ins.	Rajputana Maiwa. 3 ft. 3½ ins.	Jodhpore section. 3 ft. 3½ ins.	Bikaner section. 3 ft. 3½ ins.	Bengal North-Western, Tirhoot section. 3 ft. 3½ ins.	Gaekwai Dahoi. 2 ft. 6 ins.	Morvi. 2 ft. 6 ins.	Coch Behar. 2 ft. 6 ins.	Jorhat. 2 ft. 6 ins.
Miles open ..	59	108	1674	321	44	342	72	94	22	28
Weight of rails per lineal yard ..	miles lbs.	60	50	40	40	40	30	30	30	18 & 14
Preliminary expenses per mile ..	44	39	124	9	12	40	36	14	28	1
Laud ..	27	32	72	0·4	—	214	—	1	29	18
Formation ..	164	183	397	51	122	235	405	234	237	237
Bridgework ..	333	356	1183	50	9	889	520	169	187	187
Fencing ..	23	128	144	1·3	0·5	199	2	2	9	9
Ballast and permanent way ..	1036	2753	2033	976	1105	1755	985	762	860	921
Sations and buildings ..	175	696	974	80	101	691	271	30	87	236
Plant ..	24	54	157	11	9	127	9	12	20	114
Rolling stock ..	9	—	1130	225	181	675	271	278	217	445
General charges ..	866	177	457	20	17	299	148	92	148	120
Total cost per mile ..	£2701	£4418	£6671	£1424	£1566	£5124	£2125	£1709	£1794	£2288
Exchange calculated at rupees per £ ..	14	14	10·9	14	14	13·3	12	13·3	16	12·3

The metre-gauge lines are being relaid with 50-lb. rails instead of 40-lb.  
The standard-gauge lines are being relaid with 75 to 100-lb. rails instead of 60-lb.

TABLE R.

DETAILS OF TRAFFIC AND COST OF HAULING AND OTHER ITEMS OF SOME STANDARD, METRE, AND SPECIAL GAUGE LOCAL RAILWAYS OF INDIA.\*

	East Indian.	Bengal Nagpur.	Indian Midland.	Bengal and North- Western	Rajputana Malwa.	Jodhpore.	Bikaner.	Gaekwai Dabhoi.
Miles open ..	1610.73	862.33	734.46	756.30	1674	320	43	71.66
Mean mileage worked ..	1634.97	955.30	753.78	68,729.7	1674	3.6	43	71.66
Average cost per mile ..	2,23,926	1,10,086	1,25,287	144	129	259	22,202	20,290
Gross earnings per mean mile per week ..	"	"	49.17	62.72	43.20	41.12	60	64
Working expenses per cent. Gross earnings ..	27.44	"	"	"	5.65	10.15	47.83	61.43
Net earnings per cent. on capital outlay ..	9.82	3.33	"	"	"	6.70	2.66	6.36
Total train miles per mile ..	"	6629	1773	1932	3024	942	747	1088
Coaching earnings per passenger train mile ..	"	4.15	3.23	3.04	2.88	2.76	3.89	3.89
Goods " " goods ..	57.0	4.14	3.55	3.47	3.52	2.87	2.28	2.05
Gross earnings ..	"	"	"	"	3.24	3.44	2.07	2.90
Working expenses ..	"	"	1.41	2.07	1.40	1.41	1.37	1.83
Net earnings ..	"	"	3.27	2.14	1.81	2.03	1.51	0.80
Average number of passengers in a passenger train ..	"	No. 262	260	175	246	255	228	246
Distance travelled by a passenger ..	"	miles 209	4.9	68	35	34	39	—
number of tons in a goods train ..	"	tons 110	1.01	97	100	56	34	29
distance hauled of a ton of goods ..	"	miles 223	9.9	140	127	79	39	—
number of vehicles in a passenger train ..	"	No. 14	1.9	11	16	13	—	—
Goods ..	"	No. 33	1.14	28	32	24	—	—
mixed train—coaches ..	"	"	1.16	9	12	12	10	8
mixed train—goods vehicles ..	"	"	1.4	13	11	9	12	7
Average cost of hauling one mile—passenger unit ..	"	pies 0.60	1.30	1.62	0.78	0.68	—	1.44
Average cost of hauling one mile—goods ..	"	"	1.52	3.57	4.44	2.48	2.96	—
Average sum received for carrying one mile—passenger ton of Goods ..	"	"	2.70	2.05	2.87	2.10	2.08	12.0
" " " " ton of Goods ..	"	"	52.4	7.21	6.76	6.72	9.79	3.00
Coal—cost per ton ..	"	Rs. 1.86	3.18	8.62	6.97	18.19	26.18	—
" per train mile ..	"	0.71	1.22	3.85	1.54	3.82	4.87	4.74
Consumption per train mile ..	"	lbs. 53.64	4.826	50.14	30.86	30.73	26.05	25.33
" 1000 gross tons miles ..	"	"	148.50	132.26	161.50	132.61	148.51	—
Engine mileage, each engine per day ..	"	miles "	57	4.6	43	48	r2	4,391,080
Number of passengers carried one mile ..	"	"	1,049,362,500	107,588,232	119,385,638	177,807,946	31,860,316	2,568,759
tons of goods ..	"	"	1,180,491,905	122,613,067	14.18	16	8,449,191	639,483
Average number of passengers ..	"	"	"	"	1.4	15	20	411,720
" tons of Goods ..	"	"	"	"	4.6	3.6	4.2	—

\* Compiled from Railway Administration Report for 1883.

## CEYLON RAILWAYS.

*Gauge, 5 ft. 6 ins. ; rails, 72 lbs. per lineal yard.*

The railways in Ceylon, as regards construction and equipment, are fully up to the standard of the Indian main lines. Exception may, perhaps, be taken to the first-class carriages, which are about equal to the best second-class on the main lines in the United Kingdom.

The main line of Ceylon formerly ran from Colombo to Kandy, a distance of  $74\frac{3}{4}$  miles. It has been continued from Peradeniya, near Kandy, to Nanu-Oya, and on to Bandarawela, a distance of 160 miles from Colombo, crossing on its way a summit of 6200 feet above sea level. For the first 52 miles the line is through a fairly level and rather swampy country, with gradients of 1 in 100, and minimum curves of 10 chains radius. It then ascends for 12 miles by a continuous gradient of 1 in 45. In this distance it passes through ten tunnels, all in solid rock, and traverses a succession of reverse curves of 10 chains radius.

In several places the formation is galleried out of the solid, almost perpendicular, rock, showing to the passenger who has the nerve to look at it, a sheer descent of 500 feet into the valley below, from which the rice cultivation is extended, by terraces, several hundred feet up the hillsides. From the top of this incline at Kaduganawa to Peradeniya Junction, 7 miles, and Kandy, 4 miles, is an easy run through a comparatively level valley.

A branch of 16 miles runs from Polgahawela to Kurunegala, another of 18 miles from Kandy to Matale, and a main line southwards, skirting the west coast, from Colombo to Galle and Matara, a distance of nearly 100 miles.

The whole of the country traversed by these lines, excepting the coast and low-country section, is rugged, broken, and steep, and in many places the slopes of the hills are almost precipitous; ravines up to a hundred feet in depth have to be crossed frequently, especially in the higher parts, where curves of 5 chains radius are commonly met with. The ruling gradient on the section from

Nawalapitya to Bandarawela is 1 in 44, and between the former place and Hatton there is a continuous run of this for 6 miles.

On the Nanu-Oya section, for a distance of 40 miles, only 13 are on the straight. As the crow flies, the distance between Nawalapitya and Nanu-Oya is only 18 miles, or less than half the distance by the railway. In travelling over the up-country sections of these railways, one wonders why such a gauge as the 5 ft. 6 ins. was ever adopted for such a country.

So difficult is it for railway construction that the survey alone of the extension from Nawalapitya occupied a chief engineer and a considerable staff for four years, and cost £445 per mile of line adopted.

The capital cost of the line from Colombo to Kandy was, in 1868, when completed, Rs.233,354 per mile, or in sterling—the rupee having been in those days rather above than below par—£23,335.

The cost of the whole of the up-country lines has ranged from £15,000 to over £23,000 per mile, whereas a first-class metre gauge could have been constructed for half the cost, and, with a double line of rails, would have given a far better service of trains.

The passenger trains on the 5 ft. 6 ins. gauge, with 5-chain curves and 1 in 44 gradients, crawl along at the rate of 12 miles an hour, very much, no doubt, to the interest and pleasure of the tourist in an interesting and highly picturesque country, but rather aggravating to the planter, satiated with frequent repetitions of the scene, and longing to be back in his factory, to make more of the world-celebrated Ceylon tea.

The traffic in so small an island can only be limited, and the adoption of a narrower gauge, one more suited to the circumstances and situation, has been the subject of discussion for many years; but latterly, in view of the construction of a line through the undeveloped north of the island, to connect both with the thickly populated Jaffna peninsula and the South Indian lines, the agitation has been revived with greater vigour and effect; and it seems more than probable that the northern, as well as all future, extensions in the so-called low country, will be on a metre gauge.

As a break of gauge where two systems meet is unavoidable, it is considered better to minimize a necessary evil by making

Colombo the base for both the projected Northern line as well as the extension into the Kelani Valley, and probably another out of that line to and beyond Ratnapura.

The Northern trunk line, about 200 miles from Kurunegala to Jaffna, is required for the development of an immense tract of country, at present waste; to connect Colombo with Jaffna, and Colombo with the South Indian railways.

Considering the importance of the traffic when a junction is made with the Indian railways, the extension to Colombo of the metre gauge would not only be a necessity, but it might be found necessary to extend it from Kurunegala, also, to Kandy or Peradeniya, so that the transfer of traffic between India and the highlands of Ceylon, may be made above the Kaduganawa incline. The adoption of a narrow gauge, allowing large reduction in first cost, while being sufficient for the traffic, has not hitherto found favour with Government officials.

Ceylon has at present nearly 350 miles of single broad-gauge line, earning not much more in the aggregate than the average of the Indian lines. It is not too much to say that if metre gauge had from the outset been adopted, trains might to-day be running over 600 miles, constructed for the same capital outlay.

The example of, and lessons from, the broad- and narrow-gauge lines of India, and the comparison between the two systems in cost of construction and traffic earnings, seems to have been thrown away on the Administrators of the Government of Ceylon, and all their efforts would appear to have been directed, not to give a line cheap and sufficient for all purposes, but by hoisting periodically the "evil of break of gauge," to bolster up a system that was found too broad and costly for India, and which has been persisted in in Ceylon, in spite of the lesson over there, now so long before their eyes, and so instructive to those who have open minds to take them into consideration.

For example, there is the lesson of the Oude and Rohilkund, a 5 ft. 6 ins. line of about 800 miles single line, costing over Rs.126,000 per mile, through a comparatively easy country, with gross traffic earnings of Rs.262 per mean mile worked per week, and giving in 1894 a return of 5.58 per cent. on capital outlay

against that of the Rajputana-Malwa line of 1674 miles of single metre gauge costing Rs.76,003 per mile, over a rather more difficult country, with gross traffic earnings of Rs.285 per mile per week, and giving a return of 7·88 per cent. on capital outlay. It was in former years over 10 per cent.

The latest effort to prop up the cause of the 5 ft. 6 ins. gauge against the assaults made on it has been the production of an estimate by the Chief Resident Engineer for Railway Construction for a light line to Jaffna from Kurunegala, of which the items and their amounts are given below, viz. :—

							Per mile. £
Earthwork	...	...	...	...	...	...	232·8
Bridges and culverts	...	...	...	...	...	...	469·5
Permanent way—Material			£1009·4				
" Laying and ballast	316·6			...	...	...	1326·0
Fencing	...	...	...	...	...	...	17·3
Felling trees and clearing land	...	...	...	...	...	...	10·6
Level crossings and miscellaneous works	...	...	...	...	...	...	65·7
Stations	...	...	...	...	...	...	106·6
Telegraph	...	...	...	...	...	...	21·8
Land and compensation	...	...	...	...	...	...	28·0
Rolling stock	...	...	...	...	...	...	162·3
Engineering and administration	...	...	...	...	...	...	117·7
Contingencies	...	...	...	...	...	...	179·2
Total	...	...	...	...	...	...	£2737·5
Rs.18 $\frac{1}{2}$	= £1	sterling.					

NOTES.—Curves, minimum 19 chains radius. Gradients, maximum 1 in 132. Rail level, 15 ins. above formation. Four-wheeled rolling stock of the simplest description to be used as preferable to bogie stock. Stations to have no platforms. Land and compensation at £28 per mile: this is mostly Crown land, and, therefore, no charge made for it.

This estimate for a 5 ft. 6 ins. gauge railway, equipped with rolling stock, is lower than the actual cost of any similar line yet constructed in India—where the country is more favourable for railway construction, and where wages are considerably lower. The General Manager not being satisfied with the accommodation provided for in this estimate, the amount was, to suit his requirements, increased to £3298 per mile. Further alterations in this estimate, in the direction of increasing it, are expected by those who know the district through which the line would run.

If special rolling stock of the simplest kind only, is to be provided for future extensions on the 5 ft. 6 ins. gauge, it cannot work with the heavier rolling stock over the up-country lines; and if the permanent way is not heavy enough to carry the main-line rolling stock, this stock cannot travel over the extensions, and, consequently, there will be break of gauge, or its equivalent, viz. transhipment. But, in any case, there must be break of gauge for the Indian traffic at some point or other, and it would surely be better to have the transhipment done at Colombo, the neutral axis of the traffic, than at Manaar, the focus of the greatest traffic.

The railways in Ceylon, though constructed at so extravagant a cost, have been a good investment, because they have been run through either thickly populated provinces or districts abounding in traffic; but on many of the lines to be made the traffic has in great measure to be created, and it would be the height of folly to begin these with lines, three or four times the capacity, that will be required for many years to come.

#### NEW SOUTH WALES.\*

**The Railways in New South Wales** are constructed on the 4 ft. 8½ ins. gauge, and, up to the present, a narrower gauge has not been introduced. They are constructed, equipped, worked, and maintained in the best possible manner, and carry a very heavy traffic at comparatively low rates for a colonial railway. The railways have to cross rough and precipitous mountain ranges before reaching the plains of the interior, and, consequently, the cost of construction has been high. The gradients are heavy and numerous, ranging from 1 in 30 downwards, and the highest point reached is 4471 ft. above sea level.

The total cost of the railways has been £14,335 per mile, including equipment, and they carry on the average 1068 passengers, and 1439 tons of goods per mile per annum; the total number of passengers being, 19,265,732, of whom 16,672,543 are suburban.

The rates for agricultural produce are low, being about  $\frac{1}{2}d.$  per ton per mile, and in a country like New South Wales and other colonies,

\* Government Report on Railways for 1893.

it is very important to fix as low a rate as possible for the traffic, on account of the long distances the traffic has to travel from the interior to the coast. A cheap mileage rate is also in force for long distances, by which the traffic pays very little extra rate, after a certain distance has been travelled. The average haulage of goods is 60·64 miles, and the average tonnage of trains is 58 tons.

The colony has a number of branch lines in the outlying districts, constructed at such a cost per mile, that the traffic is not sufficient to pay anything towards the interest on capital, and in some instances not even working expenses. The mileage of these lines, 17 in number, amounts to 1112 miles, or nearly half the total railway mileage, and the annual loss to the colony, after paying working expenses and interest, amounts to £324,000. With the exception of two, on all these lines there is sufficient traffic to pay working expenses and a little towards the interest; therefore it is the capital cost that requires to be kept down, and it is probable, this can only be done by breaking the connection from main-line principles, and substituting a narrower and a lighter line for branches. The capital cost would not only be reduced by this method being followed, but the working expenses also, though it must be admitted that the branch lines seem to be economically worked at present. It has been suggested by the Commissioners that branch lines should be constructed on the present gauge, at a cost of £1750 per mile, exclusive of bridges and rolling stock. At this figure, would it not be better to have a substantial narrow line than a cheap broad one?

There is every provision on the lines for the present traffic, and a largely increased traffic could be carried without any material increase in the accommodation. A large proportion of the relaying is being done with 80-lb. steel rails, instead of the 70-lb. iron rails originally laid, and ironbark sleepers have been exclusively used for all renewals; this is being paid for out of working expenses, at the rate of 65 miles per annum.

The number of men employed on maintenance on lines of the heaviest traffic is from 0·94 to 0·69 men per mile, whilst the lines selected as local lines in Table S are maintained as under—

Junee to Hay	...	...	...	...	0·41	men per mile
Gundagai branch	...	...	...	...	0·35	" "
Nyngan-Cobar do.	...	...	...	...	0·29	" "

With regard to the rates for agricultural produce, the Commissioners, in their report, say—

“ As has been shown, the rates for agricultural produce have been made especially low, in consequence of the settlement that the cultivation of the land induces, and owing to the fact that unless exceedingly low rates were adopted for the outlying districts, it would be impossible to raise grain in districts at long distances from the seaboard. The following rough estimate of the value to the railways of 10,000 acres of land under cultivation, as against 10,000 acres of land employed for running sheep, will strongly illustrate this point.

“ A distance of 300 miles from Sydney has been adopted in each case.

“ *Agricultural Result.*

“ The average yield over the whole colony for the past three years has been 12½ bushels per acre ; which gives—	£ s. d.
3304 tons @ 14s. ... ... ... ...	2312 16 0
Carriage of wheat-bags ... ... ... ...	84 14 8
Machinery and implements of all kinds, binder twine, etc., materials for repairs, etc. ... ... ...	350 0 0
Rations, clothing, etc., for one man for every 100 acres = 100 men ... ... ... ...	398 0 0
(No allowance made for families, nor for travelling upon the railways, which would be a fair additional revenue)	
	<u>£3145 10 8</u>

“ If the crops were reaped, and the straw sent to market, a large additional revenue would result.

“ *Pastoral Result.*

Average for the whole colony gives one sheep to 2½ acres = 11 tons of wool @ 72s. (5½ lbs. per sheep)	£ s. d.
	39 12 0
Increase of the flock to be reduced by 25 per cent. each year, by trucking to market, or by boiling down ; say 600 sheep trucked, and 525 boiled down ... ...	44 4 4
Wool-packs, rations for one man to every 4000 sheep continuously, and two men for 14 days per 1000 sheep at shearing time ... ... ...	6 13 0
	<u>£90 9 4</u>

“ Allowing £20 per annum for each 10,000 acres for materials or improvements (as fencing, etc.), it gives a total revenue of £110, against £3145 per 10,000 acres under crop.

“ In addition to the enormous disadvantages these lines labour under, owing to the great amount of severe grades, we have the very great disadvantage of a large proportion of our business being “unbalanced,” that is, trucks have to be hauled

to a very great extent empty in one direction, so practically reducing the earning powers of the train mileage by one-half.

"One great feature in American railroad working which has had an enormous effect in enabling companies to reduce their rates, has been the adoption throughout the country, to a great extent, of sending traffic in truck loads, in the same way as has been in operation for a considerable time with the competitive traffic of the Darling, Riverina, and other districts. If our customers would combine together with their fruit and other business, and consign full truck loads of traffic, it would economize the working expenses of the railway, and it could be made to work very much to the personal advantage of those using the railways.

"What is wanted is volume of traffic, which can only be obtained in connection with increased population and the greater development of the land. If, on a large proportion of our railway lines, instead of running trains once a day, and on some only three days a week, we had trains running five or six times a day each way, even at our lowest existing rates, it would add largely to the net earnings, and so assist to reduce all rates."

In their report for 1894, the Commissioners say—

"We have for some years past urged that for new extensions in purely pastoral and level country, where the traffic would be exceedingly light, a line capable of carrying a light locomotive, with the ordinary class of rolling stock, at a speed of about 15 miles an hour, in daylight only, could be constructed, exclusive of bridges, waterways, and station accommodation (which latter should be of the most simple nature), for £1750 per mile. This could only be a pioneer railway, and would be altogether different from a standard railway line, even of light construction, such as that from Nyngan to Cobar. It would be simply a line to carry traffic with reasonable speed, at a lower scale of charges, than it is now carried by road. The rates for such lines would bring about a material saving to the users, compared with what is paid for the carriage by road, and the scale of charges should be such as to avoid any material loss to the country. Lines of this character would avoid the great disadvantage of break of gauge; they would cost scarcely anything more in the first instance than a narrow-gauge line, and the whole of the ordinary rolling stock, exclusive of the engines—which could be selected from the lightest types existing in the service—could pass over them, and thus avoid the great disadvantage, and cost of creating a new class of rolling stock.

"These lines, if constructed in districts warranting railway communication, should not be any great burden to the country. We have shown in our annual reports, in connection with a number of unprofitable lines, made in the past, of the expensive type, they, with scarcely any exception, supply sufficient earnings to pay all working expenses, and to contribute a small amount towards the interest on the cost of construction, thus showing the great importance of keeping the capital cost as low as possible. If this is effected, all the contingent advantages of the pioneer lines collecting business for the parent lines would be secured, in return for a small contribution from the parent system for interest on capital. The settlers would then have the great facility of moving their produce and stock cheaply and promptly."

As instances of poor traffic-producing districts, into which branch railways have been run, the receipts of the Nyngan-Cobar and Lismore-Tweed lines, may be compared with the other two branch

lines selected. The working expenses are certainly low on these lines, but notwithstanding the evils of the break of gauge, it may be open to question whether lighter and narrower-gauge lines should not first be put down in such districts, at a cost not exceeding £2000 per mile, including rolling stock. By adopting such lines, costing only the same amount as a good road, and much less expensive in maintenance, many more miles of railway could be laid down, and a larger extent of country opened up than would otherwise be possible were a more expensive type of railway adopted for local lines.

On the Lismore-Tweed line, there is only shelter accommodation at the stations, and no platforms.

## NEW SOUTH WALES.

TABLE S.  
PARTICULARS OF COST, REVENUE, AND WORKING EXPENSES OF SOME RAILWAYS IN NEW SOUTH WALES.\*

		All Railways.	June to May.	Coofamundra to Gundagai.	Nyngan to Coonabar.	Nyngan to Coonabar.	Lismore—Tweed.
Miles open	miles	2,428	167	34	81	—	634
Cost per mile, including rolling stock	£	14,335	6247	7420	8669	—	—
Receipts per mile, passengers	..	..	..	—	—	—	48
", goods	..	..	..	—	—	—	21
Gross earnings	..	..	..	..	..	..	—
Working expenses	..	..	..	per mile	..	..	—
Net earnings	..	..	..	..	..	..	69
Gross earnings	..	..	..	..	..	..	83
Working expenses	..	..	..	per train mile	..	..	—
Net earnings	..	..	..	..	..	..	2 8
Working expenses of gross earnings	..	..	..	s. d.	..	..	—
Net return on capital	..	..	..	..	..	..	—
Maintenance	..	..	..	..	..	..	—
Locomotive power	..	..	..	..	..	..	—
Repair and renewal of carriages and waggons	..	..	..	..	..	..	—
Traffic charges	..	..	..	..	..	..	—
General charges	..	..	..	..	..	..	—
Other charges	..	..	..	..	..	..	—
Maintenance	..	..	..	..	..	..	—
Locomotive power	..	..	..	..	..	..	—
Repair and renewal of waggons, etc.	..	..	..	..	..	..	—
Traffic charges	..	..	..	..	..	..	—
General charges	..	..	..	..	..	..	—
Other charges	..	..	..	..	..	..	—
Passengers carried per annum	..	..	..	per train mile	..	..	—
Tonage of goods	..	..	..	..	..	..	—
Passengers carried	..	..	..	..	..	..	—
Tonage of goods	..	..	..	..	..	..	—
Train mileage	..	..	..	..	..	..	—
Men employed on maintenance	..	..	..	..	..	..	—
Cost per mile of rolling stock only	..	..	..	..	..	..	—
				train miles	..	..	—
				man	..	..	—
				£	..	..	—
					0·94 to 0·18	0·35	0·29
					2,073	568	333
						161	—
							0·18

\* Compiled from Government Report on Railways, 1893.

† 16,672,543 suburban traffic.

‡ Not reckoning suburban traffic.

For the year 1894.

For the year 1893.

## CAPE GOVERNMENT RAILWAYS.

These railways are constructed and worked by the Cape Government, they are on the 3 ft. 6 ins. gauge, and have cost nearly £9000 per mile, including equipment. They were originally laid with 40-lb. iron rails, afterwards increased to 45 lbs., and now all relaying is done with 60-lb. rails. Both steel and wood sleepers are used. The maximum gradient is 1 in 40, and the sharpest curve 5 chains. The rolling stock is of the best description made for this gauge; travelling is very comfortable, and all the railways are maintained and equipped in the best possible manner.

Before the opening up of Johannesburg, the railways did not pay the full interest on capital, after deducting working expenses, even when the diamond industry of Kimberley was in full swing. Now that a large accession of traffic goes over the railway to the Transvaal, to Bechuanaland, and to the north, the earnings of the whole system is now over 5 per cent. per annum.

South Africa is a country of samples. Mineral and fertile districts are found here and there, rich and luxuriant, but these are generally removed long distances from markets, and from the railways.

Agriculturally, the Cape Colony is in a worse position to-day than it has been for many years past, and the chief problem before the colony is as to the best means of developing her internal resources, and getting a population on the land. It is monstrous to think that a country like South Africa cannot support the 500,000 white people in grain, and that she has to import largely from Australia. It is useless to think of placing a larger white population on the land, until better communication to markets has been provided, and in some districts also until water has been stored for irrigation purposes.

In the opinion of those best qualified to judge, the railway must go first, and, whilst the people are being settled on the land, irrigation works can proceed; but it is quite useless to think of extra production until some means are in vogue, cheaper and more expeditious than the bullock-waggon, for carrying the produce to market.

All our colonies have constructed branch lines on the same lavish expenditure as their main lines, and now find that they cannot proceed further with railway construction for want of funds.

Yet the country cannot progress agriculturally without better means of communication. The countries are poor, the people are poor, and produce has to travel long distances to market, yet all the branch lines constructed in our several colonies show traffic sufficient to pay more than working expenses.

In this colony, to earn £332 per mile per annum at fairly high rates, the Graaf Reinet branch has cost £7800 per mile, and has a train service of one train per day each way. The Malmesbury branch, earning £450 per mile, has cost £5800 per mile, and the Cape Central, a private branch, earning £297 per mile, has cost £4700 per mile, without rolling stock, since reconstruction, returning 4 per cent. to the debenture holders, and nothing to the ordinary shareholders. It seems that a traffic of £250 per mile may be fairly reckoned upon as the amount to be expected from any branch line constructed in the colony, and that, except in special instances, a larger traffic will not be obtained, unless some means are forthcoming for developing the land and putting more people upon it. With this income, if branch lines are to be constructed in the colony without being a burden on the resources of the country, they must be constructed and equipped at a cost not exceeding £2500 per mile.

The locomotives weigh 30 tons and upwards, carrying 600 gallons of water, but engines of 40 tons' weight are now being introduced. The consumption of coal averages 30 lbs. per train mile.

The coaching stock consists of short carriages, and bogie carriages, with corridors and sleeping berths. The wheels are 33 ins. diameter. The short coaches are 16 ft. long, 7ft. 3 ins. wide (outside), with a wheel-base of 8 ft.

The waggon stock consists mostly of the short type, having an inside length of 14 ft. and an outside width of 7ft. 3 ins. The waggon most generally useful is a short cattle-truck with gabled ends, and a bar longitudinally connecting their points, to which a tarpaulin is fixed, thus converting it into a covered waggon. In the early days, the bogie waggon was not found very satisfactory, owing to the increased expense of haulage and repair, and the difficulty of getting sufficient traffic to fill the individual waggons, but with the opening up of the gold-fields, the bogie stock is found very economical for the long-distance traffic.

The only railway worked and constructed by a private company in the Cape Colony that has been able to earn any interest on its capital is the Cape Central Railway. This line runs from Worcester to Ashton. The capital of the company has been reconstructed, and now consists of—

Ordinary shares	...	...	...	...	...	£96,680
Debentures 4 per cent.	...	...	...	...	...	98,400
Total	...	...	...	...	...	<u>£195,080</u>

The net revenue of the railway is sufficient to pay interest on the debenture stock, but no dividend is paid on the ordinary stock.

#### AN EXPERIMENTAL RAILWAY NEAR DERBY.

Mr. Percival Heywood's experimental 15-in. gauge railway (Plate XXXI.), is laid with 14-lb. rails and steel sleepers, and equipped with rolling stock, and has cost about £1200 per mile.

The locomotive most suitable for ordinary work has  $4\frac{3}{4}$  ins. cylinders, 7 ins. stroke, and weighs, in working order, 2 tons 10 cwts., hauling, on the level, 29 tons; up 1 in 50, 12 tons; and up 1 in 12, 3 tons. It cost about £400.

With a traffic of only 5000 tons passing over the line, the cost of transport, including interest on capital, and all working expenses, is about 1s. per ton per mile; but, if the engine is worked up to its full capacity of 20,000 tons, the cost would be less than one-half.

The waggons are 5 ft. long by 2 ft. 6 ins. wide inside, weighing 5 cwts., and carrying 30 cwts., and cost £8 each.

The passenger carriages are 19 ft. 6 ins. long by 3 ft. 6 ins. wide, and carry 16 persons, two abreast. They weigh 20 cwts. each (140 lbs. per passenger), and cost £37 each.

The railway has been working very satisfactorily on the estate for nearly 20 years.



100 PHOTO SPAGUE & CO. LONDON

MR. PERCIVAL HEYWOOD'S EXPERIMENTAL RAILWAY. GAUGE 1 FT. 3 IN.

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TABLE I.  
PARTICULARS OF COST, REVENUE, AND WORKING EXPENSES OF SOME RAILWAYS IN THE CAPE COLONY, SOUTH AFRICA.\*

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\* Compiled from Railway Manager's Report, 1893.

Without rolling stock. † Labour only.

Three millions suburban and season tickets.

## CHAPTER XI.

*RATES, FARES, AND WAGES ON DIFFERENT RAILWAY SYSTEMS.\**

## ENGLAND AND WALES.

**Glyn Valley Railway.—**

					<i>d.</i>		per ton per mile.
Stone	...	...	...	...	2		
Slates	...	...	...	...	3½	"	"
General goods	...	...	...	...	9½ to 1s. 1d.	"	"
Agricultural produce	...	...	...	...	5 to 8d.	"	"
Hams and bacon	...	...	...	...	10¾	"	"
Hay	...	...	...	...	10¾	"	"
Grain	...	...	...	...	7¾	"	"

These rates include terminal charges and transhipment.

**Wisbech and Upwell.—**

Passenger fares—1st class	...	...	...	...	...	¾ <i>d.</i>	per mile.
"	2nd class	...	...	...	...	½ <i>d.</i>	"

The wages paid on railways outside the large companies are generally—

				<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	
Gangers	...	...	...	...	4	0 to 5	0	per day.
Labourers	...	...	...	...	2	10 to 3	9	"
Engine-drivers	...	...	...	...	4	6 to 6	0	"
Firemen	...	...	...	...	3	6 to 4	0	"

## IRISH LIGHT RAILWAYS.

Iron ore, coal, and lime	...	...	1 <i>d.</i> to 1½ <i>d.</i>	per ton per mile.
Sand	...	...	2 <i>d.</i>	"
General rate for goods	...	...	2½ <i>d.</i> to 4 <i>d.</i>	"

\* These rates are very incomplete. The author did not delay the publication of the work until such time as they could be completed.

### Transhipping—

Iron ore ... ... ... ... ... ... ...  $\frac{1}{2}d.$  per ton.  
 General goods ... ... ... ... ...  $1\frac{1}{2}d.$  to  $4d.$  "

### Fares —

1st class      ...      ...       $1\frac{1}{2}d.$  to  $2d.$  per mile, average  $1\frac{1}{2}d.$  per mile.  
 3rd class      ...      ...       $3d.$  to  $1\frac{1}{2}d.$       "      "       $1d.$       "

The wages paid are—

						s.	d.	s.	d.
Gangers	...	...	...	...	...	2	4	to 2	6 per day.
Labourers	...	...	...	...	...	1	10	to 2	0 "
Engine-drivers	...	...	...	...	...	5	0	to 7	0 "
Firemen	...	...	...	...	...	3	0	to 4	0 "

## BELGIAN LIGHT RAILWAYS.

In addition to the above rates, a charge is made on each consignment of 5d. for full loads of 80 tons, and of 1*2*½d. for part loads of 2 tons minimum.

1st class passenger ...   ...   ...   ...   ...   ...   ...   ...   1d. to  $\frac{1}{4}$ d.  
 2nd   "   "   ...   ...   ...   ...   ...   ...   ...    $\frac{3}{4}$ d. to 1d.  
No third class.

## NEW ZEALAND.

Rates not given in report.

The wages are—

			s.	d.	s.	d.
Labourers	...	...	6	6	6	per day of eight hours.
Gangers	...	...	8	0	„	„
Mechanics and smiths	...	9	0 to 10	6	„	„
Engine-drivers	...	10	0 to 13	0	„	„
Firemen	...	7	6 to 9	0	„	„

## SOUTH AUSTRALIA.

The average *receipts* per ton of goods per mile was, for 1893, 1·42*d.*, and the average distance travelled was 116·16 miles.

The initial rate for grain of  $2d$ . per ton per mile for short distances

has been reduced to  $1\frac{3}{4}d.$ , and the former minimum rate of  $1d.$  has been reduced to  $\frac{1}{2}d.$  per ton per mile.

Live stock are conveyed as under, at per truck per mile—

							Cattle. d.	Sheep. d.
First	25 miles	...	...	...	...	...	9·6	9·6
Second	25 "	...	...	...	...	...	8·4	8·4
"	50 "	...	...	...	...	...	7·0	7·0
"	100 "	...	...	...	...	...	5·0	5·0
Third	100 "	...	...	...	...	...	3·0	3·0

The wages paid in this colony are—

	s.	d.	s.	d.	
Labourers	...	...	...	6	0 per day of eight hours.
Packers	...	...	6	0 to 6	6
Gangers	...	...	7	0 to 7	6
Carpenters	...	...	8	6	"
Fitters	...	...	14	0	"
Masons	...	...	8	0	"
Enginemen	...	...	8	6 to 14	0

### INDIAN RAILWAYS.

Food grains—				d.
1 to 100 miles	...	...	...	0·79 per ton per mile.
101 to 200 "	...	...	...	0·56 "
201 to 400 "	...	...	...	0·33 "
over 400 "	...	...	...	0·22 "

When in consignments of 5·88 (160 maunds) tons and over.

Coal—				d.
1 to 100 miles	...	...	...	0·45 per ton per mile.
101 to 200 "	...	...	...	0·40 "
201 to 400 "	...	...	...	0·33 "
over 400 "	...	...	...	0·22 "

Ordinary goods rates per ton per mile—

1st class.	2nd class.	3rd class.	4th class.	5th class.
0·79d.	1·18d.	1·58d.	1·93d.	2·25d.

But on the Jodhpore-Bickaneer line, the following—

1·12d.	1·69d.	2·13d.	2·59d.	3·05d.
1st class passenger	...	...	...	1d. to $1\frac{1}{2}d.$ per mile.
2nd "	...	...	...	$\frac{1}{2}d.$ to $\frac{3}{4}d.$ "
Intermediate "	...	...	...	$\frac{1}{4}d.$ to $\frac{5}{8}d.$ "
3rd class "	...	...	...	0·16d. "

Transhipment, including all loss, demurrage, and damage,  $1\frac{1}{2}d.$  to  $2d.$  per ton.

## NEW SOUTH WALES.

The *earnings* of the several kinds of merchandize are as under—

					d.
Coal and shale	...	...	...	...	0·72 per ton per mile.
Firewood	...	...	...	...	0·88   , ,
Grain, flour, etc.	...	...	...	...	0·63   , ,
Hay, straw, and chaff	...	...	...	...	0·45   , ,
Timber, lime, manures, fruit, etc., bricks, gravel, etc.	...	...	...	...	0·84   , ,
Wool	...	...	...	...	2·48   , ,
Live stock	...	...	...	...	2·00   , ,
All other goods	...	...	...	...	2·58   , ,
Average earnings on the tonnage carried				1·62	, ,

*Rates*—

			d.
Flour, meal, and potatoes—	100 miles	...	1·0 { per ton per mile,
	200   , ,	...	0·7 } six-ton lots.
	300   , ,	...	0·56   , ,
	500   , ,	...	0·39   , ,
	1000   , ,	...	0·275   , ,

			d. per ton per mile,
Ores—	100 miles	...	1·0 five-ton lots.
	200   , ,	...	0·94   , ,
	300   , ,	...	0·83   , ,

With a reduction for several trucks per week.

			d.
Fruit—	50 miles	...	1·4 per ton per mile.
	100   , ,	...	1·3   , ,
	200   , ,	...	1·12   , ,
	300   , ,	...	0·90   , ,

	50 miles	1 ton and over.	Small lots	
			d.	under 1 ton.
Dairy produce—	50 miles	2·12 per ton per mile.	4·5	per ton per mile.
	100   , ,	2·06   , ,	4·35   , ,	
	200   , ,	1·88   , ,	3·41   , ,	
	300   , ,	1·65   , ,	3·48   , ,	

Parcels—	3 lbs. and under, each	50 miles.	150 miles.	300 miles.	Any distance.	
					s. d.	s. d.
	7 lbs. to 14 lbs.	0 6	1 0	1 9	2	6
	28 lbs. to 56 lbs.	1 0	2 6	4 0	6	0
	98 lbs. to 112 lbs.	1 9	5 0	7 3	11	0

The existing rates (1894) for grain, etc., is as follows:—

Grain, flour, meal, bran, pollard, millet seed, beet-root, chicory-root, potatoes, etc., on up journey, <i>per ton</i> , in 6-ton truck loads.			Hay, straw, chaff, green fodder, and ensilage <i>per truck</i> , not to exceed 6 tons.		
Miles.	s.	d.	£	s.	d.
100	8	4	1	18	1
150	10	0	1	18	10
200	11	8	2	8	6
250	12	3	2	15	0
300	12	9	3	1	6
350	13	3	3	7	6
400	13	9	3	13	6
450	14	3	3	19	6
500	14	9	4	5	6

The wages paid are—

			s.	d.	
Labourers	...	...	7	6	per day.
Packers	...	...	7	6	"
Gangers	...	...	8	6	?
Carpenters	...	...	11	0	"
Fitters	...	...	13	0	?
Masons	...	...	11	0	?
Enginemen	...	...	14	0	"
Firemen	...	...	9	0	"
Cleaners	...	...	6	0	"

The passenger fares are—

1st class	...	...	...	...	2½d. per mile.
2nd	"	...	...	...	1½d. "
					Excursion, 33½ per cent. extra to single fare.
Return	50	"	"	"	

### CAPE GOVERNMENT RAILWAYS.

*Ordinary Goods Rates*—

1st class goods—	up to 333 miles.	6	per ton (2000 lbs.) per mile.
Minimum, 5s.			
2nd class—			
Minimum, 3s. 4d.	„ 25	7	"
Bedsteads, beer, furniture,	„ 50	6	"
machinery, etc.	„ 100	5·4	"
	„ 150	4·4	"
	„ 200	4·9	"
3rd class—	25	3·2	"
Minimum, 1s. 8d.	„ 50	2·6	"
Colonial bacon, coal in bags,	„ 100	2·3	"
grain in bags, timber,	„ 150	2·1	"
ag. machinery ...	„ 200	2·18	"

					<i>d.</i>	
Produce (clause 156A)—		up to 25 miles.		1·5 per ton (2000 lbs.) per mile.		
Minimum, 1s. 3d.	...}	" 50	"	1·5	"	"
South African fencing,	...}	" 100	"	1·5	"	"
pitwood, salt, hides, grain	...}	" 150	"	1·5	"	"
		" 200	"	1·5	"	"
Produce (clause 156B)—		25	"	2·0	"	"
Minimum, 1s. 3d.	...}	" 50	"	2·0	"	"
Acorns, imported fencing,	...}	" 100	"	2·0	"	"
firewood, forage, fruit	...}	" 150	"	1·9	"	"
		" 200	"	1·9	"	"
Parcels—	25	... 50	... 100	... 150	... 200	miles.
25 lbs. ...	6d.	... 1s. 1d.	... 1s. 11d.	... 2s. 6d.	... 3s. 6d.	each.
50 lbs. ...	1s. 1d.	... 2s. 5d.	... 3s. 6d.	... 4s. 7d.	... 5s. 9d.	"
100 lbs. ...	2s. 6d.	... 4s. 0d.	... 6s. 8d.	... 8s. 9d.	... 10s. 11d.	"
1st class passenger	...	...	...	...	...	3d. per mile.
2nd	"	...	...	...	...	2d. "
3rd	"	...	...	...	...	1d. "

*Cattle Rates per Short Truck (14 feet long).*

		Horses, mules, donkeys, and vehicles.			Horned cattle, ostriches, fresh meat, and fruit.			Sheep, goats, and pigs.		
		£	s.	d.	£	s.	d.	£	s.	d.
Up to 8 miles	..	0	4	0	0	4	0	0	4	0
" 25 "	..	0	12	6	0	11	3	0	9	5
" 50 "	..	1	5	0	1	2	6	0	18	9
" 100 "	..	2	1	8	1	17	6	1	10	0
" 150 "	..	2	16	3	2	10	8	1	19	5

The wages paid are—

					s. d.	s. d.
Gangers	...	...	...	...	7 6	to 10 6
Labourers (natives)	...	...	...	...	2	6 to 3 0
Enginemen	...	...	...	...	15	0 to 20 0
Firemen	...	...	...	...	7	6 to 10 0
Carpenters	...	...	...	...	10	0 to 15 0
Masons	...	...	...	...	10	0 to 15 0
Fitters	...	...	...	...	15	0 to 20 0

TABLE U.  
COMPARISON OF SOME RATES IN DIFFERENT COUNTRIES.

NAME OF RAILWAY.										
Stone, coal, etc.	per ton per mile	Glyn Valley.	Irish Light Railways.	Belgium Light Railways.	South Australia.	India.	New South Wales.	Cape Colony.	Victoria.	Queensland.
General goods	pence	2	1 to $1\frac{1}{2}$	$\frac{1}{2}$ to $2\frac{3}{4}$	—	$\frac{1}{5}$ to $\frac{1}{2}$	$\frac{1}{3}$ to 1	2 to $3\frac{1}{2}$	—	—
Agricultural produce	"	"	$3\frac{1}{2}$	$2\frac{1}{4}$ to 4	$1\frac{1}{4}$	—	$\frac{3}{4}$ to $2\frac{1}{4}$	—	5 to 7	—
Fresh fruit	"	"	"	5 to 8	—	—	—	$\frac{1}{4}$ to 1	$1\frac{1}{2}$ to 2	—
Grain	"	"	"	"	—	$1\frac{1}{4}$	—	1 to $1\frac{1}{2}$	2	—
Dairy produce	"	"	"	"	—	$\frac{1}{2}$ to $1\frac{3}{4}$	$\frac{1}{5}$ to 4	0.35 to 1	$1\frac{1}{2}$ to $3\frac{1}{2}$	—
Cattle, per truck per mile	"	"	"	"	—	—	—	$1\frac{1}{2}$ to $2\frac{1}{4}$ *	—	—
Sheep	"	"	"	"	—	—	—	4 to 8	$4\frac{1}{2}$ to $5\frac{1}{2}$	$7\frac{1}{4}$ to 11 $4\frac{1}{4}$ to $8\frac{1}{2}$
Passenger fares, 1st class per mile	"	—	—	—	—	—	$3\frac{1}{2}$ to 8	3 to $4\frac{1}{2}$	$7\frac{1}{4}$ to 11 $4\frac{1}{2}$ to $10\frac{3}{4}$	—
"	"	2nd	"	"	—	—	—	$1\frac{1}{4}$	$1\frac{1}{2}$ to $3$	—
"	"	3rd	"	"	—	$\frac{3}{4}$ to $1\frac{1}{2}$	$\frac{3}{4}$ to 1	—	$\frac{1}{6}$	1

\*  $3\frac{1}{2}$ d. to  $4\frac{1}{2}$ d. small lots under 1 ton.

## APPENDIX I.

## COPY OF REPORT, WITH APPENDICES, OF A COMMITTEE, PRESENTED TO THE RIGHT HONOURABLE JAMES BRYCE, M.P., CHAIRMAN OF A CONFERENCE ON LIGHT RAILWAYS.

SIR,

Your Committee have considered the subject referred to them, namely :—

1. How far the usual requirements of the Board of Trade as to constructing and working new railways may fairly be relaxed, especially in the case of lines built through sparsely populated and agricultural districts?
2. Whether additional legal facilities for obtaining powers to construct tram-roads and light railways are necessary or desirable?

They have given special attention to the case of light railways in agricultural districts, and they have also considered tramways and tramroads, as well in rural districts as in urban districts not of the first magnitude, but under this head they have not considered the circumstances of main lines of railway or tramway, on which the traffic may be expected to be of great volume.

For their guidance they obtained from the Board of Trade the Acts of Parliament and the existing regulations bearing upon the subject, and they consulted with its officers as to the practical effects both of the Acts of Parliament and the regulations upon railway construction and working. They were also furnished by the officers of the Board, by the Foreign Office, and by members of the Committee with information upon the subject from abroad.

In compliance with a request made to him, Sir Joseph Crowe, K.C.M.G., C.B., has sent them an account of the law and practice in France under which land is acquired compulsorily for railways of local interest in that country.

The Committee consulted those of their number who are acquainted with special divisions of the subject. The information given by Mr. Jackson as to the views of the existing railway companies was supplemented by valuable evidence from Sir Henry Oakley, the honorary secretary to the Railway Association.

Upon the information thus acquired, the Committee submit the following report :—

They find that the existing law in Great Britain specially affecting the construction and working of light railways is mainly contained in the Acts of 1864 and 1868, and the law specially affecting tramways in the Act of 1870.\*

\* Railway Construction Facilities Act, 1864, 27 & 28 Vict. c. 121, Regulation of Railways Act, 1868, 31 & 32 Vict. c. 119, Part V., and the Tramways Act, 1870, 33 & 34 Vict. c. 78.

In the case of tramways the law necessitates a confirming Act, even where no compulsory powers of taking land are demanded.

Tramroads as distinguished from tramways are only dealt with in a Standing Order of the Houses of Parliament.

Practically no light railways have been constructed under the general Acts of 1864 and 1868, owing, in part, it is alleged, to the consent of all landowners and other parties beneficially interested, and the absence of any opposition from any railway or canal company, being necessary before the Act can be made use of.

The mileage of such lines constructed under special Acts has also been inconsiderable.

This lack of progress in rural districts has also been in great measure due to the want of latitude left to the Board of Trade by law, and in other cases by the conditions which the Board considered it their duty to impose for the public safety.

It has also been stated that obstacles have arisen in the case of tramways and tramroads in consequence of the local authorities requiring conditions which were considered too onerous by the promoters of new schemes.

The Committee believe that the impediments to construction may be greatly diminished, and that on a large proportion of such lines as are contemplated by their inquiry, the regulations which have been enforced with a view to public safety may be considerably relaxed.

In the case of lines of small traffic, having few trains in the day, and working at a moderate speed, there is little risk compared with that occurring on great trunk lines having numerous sidings and branches, and carrying at high and varying speeds, a complicated traffic of passengers, merchandise, minerals, and cattle, at all hours of the day and night.

It seems reasonable that details as to route, width of gauge, fencing, level crossings, bridges, gates, the use of public roads, stations and station requirements, signals, continuous brakes, and many similar matters—unnecessary expenditure on which, taken together, adds greatly to the cost—should differ in different parts of the country, depending in each case upon the nature of the country and the traffic to be conveyed.

The same remarks apply to limitation of speed and regulations for ensuring reasonable safety in working.

There are several other items involving expenditure, such as the provision for deposit of security, the lodging of plans, advertisements, etc., in which there is room for considerable economy.

The Committee think that it is not reasonable that undertakings of limited scope, when they are approved of by the locality they are intended to serve, should be forced, as they are now, to have recourse to the expensive tribunal of a parliamentary inquiry.

The Committee are of opinion that the recent creation of popular local authorities of various degrees throughout Great Britain opens the door to an escape from the great cost attending applications to Parliament, by enabling powers and responsibilities with reference to the authorisation and control of light lines to be conferred on those bodies, and that the time has arrived for Parliament to consider whether this should not be done, an ultimate appellate jurisdiction being reserved to the Government Department charged with the inspection of railways, which, it may be assumed, would be exercised with due regard to the existence of such local control and responsibility.

If this were done, the initial cost of construction, and the expenses of working,

could be so greatly reduced that many light railways and tramways, promoted either by independent companies, or by the existing lines of railway and tramway, could be undertaken to the great advantage of districts, and especially agricultural districts, at present without satisfactory means of transport.

The Committee suggest that proposals for the construction and working of such lines should be submitted in the first instance to the County Council (with exceptional provisions as to large municipalities), subject to precautions ensuring that the interests of those directly affected are duly safeguarded. In all cases a majority of assents in number and value of owners and frontagers should be required, and in cases of compulsory acquisition of land there should be a power of appeal to the Board of Trade.

If any doubt should arise as to whether a proposed line is a light railway, to be dealt with locally, or in a scheme which, on account of its magnitude or otherwise, should properly be dealt with by Parliament, the Committee think that the Board of Trade should determine the question.

The Committee are doubtful whether it would be within the terms of the reference to them, and they refrain from giving an opinion, as to whether, and if so, on what conditions, it is desirable that local authorities should be empowered to contribute funds towards, or otherwise take part in, undertakings of this character.

(Signed)      B. SAMUELSON, Chairman of the Committee.  
 W. M. ACWORTH.  
 B. BAKER.  
 M. E. HICKS BEACH.  
 R. MELVILL BEACHCROFT. (*Subject to Appendices A. and H.*)  
 W. J. CARRUTHERS-WAIN. (*Subject to Appendix H.*)  
 CATHCART.  
 F. A. CHANNING. (*Subject to Appendices B., F., and H.*)  
 ANDREW CLARKE.  
 EDMOND FITZMAURICE.  
 CLAUD J. HAMILTON.  
 ALFRED HICKMAN. (*Subject to Appendix C.*)  
 HENRY HOBHOUSE.  
 A. C. HUMPHREYS-OWEN. (*Subject to Appendices D. and H.*)  
 W. L. JACKSON.  
 WM. THOS. MAKINS.  
 P. WALTER MEIK.  
 A. M. RENDEL.  
 ALBERT K. ROLLIT. (*Subject to Appendices E. and H.*)  
 STEPHEN SELLON. (*Subject to Appendix H.*)  
 ALEX. SIEMENS.  
 SAMUEL STOREY. (*Subject to Appendices F. and H.*)  
 SUTHERLAND.  
 THRING. (*Subject to Appendix G.*)

This Report is signed by all members of the Committee (except Sir Courtenay Boyle and Mr. Hopwood, the Officers of the Department concerned), subject to the appended memoranda by individual members.

T. C. FARRER,  
 Secretary to the Committee,  
 23rd January, 1895.

## APPENDIX A.

## MEMORANDUM BY MR. BEACHCROFT.

I have signed the above Report, agreeing generally with the suggestions so far as they go. I dissent, however, to the exclusion from the Report of all reference to the case of tramways and tramroads in urban districts of the first magnitude, believing that even if all the suggestions referred to are adopted, they will have little or no effect in solving the second of the two problems set before the Conference by the President of the Board of Trade, namely, that relating to congested populations.

The relief of the congestion of great cities, such as London, can only, as the President stated, be obtained "by providing for a better transportation of workmen to their work from suburban areas," or by enabling industries which "are now conducted in the large cities to be transferred to suburban or rural districts, by providing easier and cheaper modes of transportation from the places in which these industries would be established."

By limiting the object of the reference to the Committee, as is practically done by the Report, to the case of agricultural and small urban districts, the Committee is, I submit, shelving a responsibility, which, if not undertaken now, must be undertaken before Parliament can be asked to deal with the general question.

The conditions affecting the construction and working of tramways and tramroads, whether as to safety of the public or otherwise, in the outskirts of London differ only in degree from those applicable to such places as (say) Weston-super-Mare or Stoney Stratford—at all events, the evidence given to the Committee raised no serious distinction—in either case the main hindrances to development would apply equally; these are (1) the cost of acquiring the land where main roads are not available, and (2) the financial difficulty attending new enterprises in view of their being, to start with, almost necessarily, of a profitless character.

A revision, by Parliament, of the provisions of the Lands Clauses Consolidation Act, on the one hand, and the establishment of some system of guarantee on the other, are the points which seem most pressing for consideration, and I can only express the hope that the Conference itself will not rest satisfied without a further report on this important branch of the subject.

(Signed) R. MELVILL BEACHCROFT.

25th January, 1895.

## APPENDIX B.

## MEMORANDUM BY MR. CHANNING.

While concurring generally in the Report, I wish to add the following notes on several points of importance which, in my opinion, are dealt with inadequately in the Report.

(1.) The requirements of the Board of Trade as regards the equipment and safe working of railways are a less hindrance to the carrying out of light railways than the heavy and uncertain expenditure involved in opposed proceedings before Parliament, and in the cumbrous and costly machinery for the purchase of land.

The evidence shows that some of the requirements of the Board of Trade are recognised as indispensable by engineer experts interested in the promotion of light

railways, as well as by the inspectors of the Board. It is, therefore, desirable to distinguish clearly between such requirements and other requirements which, however necessary on ordinary railways with heavy traffic, and worked at high speed, are practically unnecessary on light railways worked at low speed and under wholly different conditions, both as regards goods and passenger traffic.

It would appear from the evidence that in most parts of this country, efficient continuous brakes, at least on engines and passenger carriages, fencing, gates at level crossings, and some mechanical regulation of speed, will generally be indispensable, and that the speed should be restricted to a maximum of 25 miles an hour in the open country down to 8 miles an hour or less in urban or suburban districts. In the second place, the weight of rails, the construction of permanent way and of bridges, the use of public roads, and other like matters, must vary considerably, according to the nature of the country traversed, and the character of the traffic provided for. In the third place, there are requirements, such as the provision of and equipment of stations and platforms, safety arrangements as regards signals and block working, etc., which will, in most cases, clearly be unnecessary on light railways of the type contemplated.

As to the first of these classes, the Board of Trade will be exceeding what is likely to be sanctioned by public opinion if any substantial modification is made in existing requirements, unless in very exceptional circumstances. As to the second class, the Board of Trade should exercise the widest and fullest discretionary powers, dealing with each case according to the special circumstances. As to requirements of the third class, the Board should release light railways from such expenditure to the utmost, unless some urgent and exceptional state of things renders it indispensable.

(2.) I think it is to be regretted that the Committee has made no effort to draw a distinct line between the light railways and tramways and tramroads contemplated by this inquiry and ordinary branch line of railways. As, however, the Committee have agreed to a paragraph which refers to the Board of Trade, the decision "whether a proposed line is, in fact, a light railway, or is a scheme which, on account of its magnitude, should properly be dealt with by Parliament," it would, in my opinion, be only reasonable that the Board of Trade in legislating on the questions here considered, should introduce some definition which would serve as a guide to county councils, to promoters, and others.

In some districts it may be most desirable and reasonable that railway companies should extend their new branches in the form of light railways. But, in other cases, it might be a grave abuse for a railway company to construct or work, on the cheaper and less efficient scale, branch lines which, owing to the population of the district and the nature of the traffic, ought, in the public interest, to be carried out and worked as branch lines are now under the normal standards of railway equipment and working.

I am convinced that Parliament and public opinion would rightly resent any attempt to lower the normal standard of ordinary branch lines to be constructed in future, which would result in unfairly sacrificing or restricting the conveniences, and diminishing the precautions for the safety of the public, in the interest of railway directors and shareholders.

(3.) Where an independent company is authorised to construct a light railway forming a junction with an existing railway, the Board of Trade should have power to compel, if necessary, the existing railway company to grant facilities, and to make a fair adjustment of the cost of services and of the receipts of charges in respect thereof as between the railway company and the light railway company.

(4.) I believe that it would tend to render the provision of light railways and tramways cheaper and more effective, and would also tend to induce county councils and urban authorities to contribute towards the expenditure necessary, or to guarantee such undertakings, if full powers were given to county councils and urban authorities to construct and work light railways on their initiative and responsibility, or to join with other county councils or authorities, or with any railway company, or independent company, in constructing or working light railways.

Where a county council thus carries out a light railway, it will obviously be necessary that the Board of Trade should be the confirming authority, and that all questions arising, whether of compensation or as to other disputed matters, should be decided by an arbitrator appointed by the Board.

(5.) In any legislation as to light railways, tramways, or tramroads, I think the employés ought to be included in express terms among the railway servants to whom the Hours of Labour Railway Servants Act, 1894, applies, unless they are already so included.

(Signed) F. A. CHANNING.

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#### APPENDIX C.

*Wightwick, near Wolverhampton,*  
SIR, *January 26, 1895.*

I beg respectfully to submit the following as an addition to the Report of the Committee.

The Secretary, (Signed) ALFRED HICKMAN.  
Light Railways Committee.

That the compensation to be paid for land taken compulsorily should be fixed by an arbitrator appointed by the Board of Trade, who should be instructed to take into account the value added to the remaining land of the same owner by the improved means of communication.

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#### APPENDIX D.

##### MEMORANDUM BY MR. HUMPHREYS-OWEN.

While concurring generally in the Report, I agree with Mr. Storey and Mr. Channing that powers in relation to light railways should be given to county councils. I think legislation desirable which would enable parts of rural counties to facilitate the construction of light railways, either by providing capital for or guaranteeing interest on the cost of construction of lines serviceable to the locality, but conferring no advantage on the county at large. Precedents for such legislation are to be found in the Lighting and Watching Act, 1833, and the Acts relating to Commissioners of Sewers, especially Part II. of the Land Drainage Act, 1861.

I think, also, that the attention of Parliament and of the Board of Trade should be directed to the evils caused by improvident methods of raising money for the construction of railways and tramways. Mr. Sellon mentions this at several points in his evidence (*see* 2141-2149; 2305), and even goes so far as to say that it

may be regarded as the largest head of expenditure (2230, 2231). Sir Henry Oakley lays down as one of the conditions of success for light railways that they should be "made with honest sovereigns" (2348), and similar views are expressed by Mr. Acworth (1880, 1895), and from French information by Major Addison (1810, 1881). In my opinion, unless a line is promoted by a public body or by an existing railway company, securities equal in value to the amount of the authorised share capital should be deposited by the promoters.

(Signed) A. C. HUMPHREYS-OWEN.

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#### APPENDIX E.

I assent generally to the terms of the Report, but expressly subject to the reservations in my remarks at the Opening Conference, and to some others in respect of tramways, especially town tramways.

(Signed) ALBERT K. ROLLIT.

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#### APPENDIX F.

We are of opinion that it would largely tend to the multiplication of light railways and to their cheaper construction, and therefore to the greater probability of their being worked at a profit, if *at least* equal optional powers to those now possessed by borough councils in the matter of tramways were conferred by Parliament on county councils with respect to light railways and tramroads, with the possible additional power of assisting such projects by some provision of capital or by guarantee, on terms approved by the Local Government Board after a local inquiry.

(Signed) SAMUEL STOREY.  
F. A. CHANNING.

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#### APPENDIX G.

Highly as I approve of the Report in general, I think, perhaps, that, in working out the details of a measure, it may be found desirable to make some modifications in relation to the intervention of the Board of Trade.

(Signed) THRING.

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#### APPENDIX H.

Whilst concurring in much that is in the Committee's Report, we express our regret that its recommendations are not more precise and specific; and we respectfully record our opinion that no legislation can be effective in securing the construction of light railways, tramroads, and tramways to any sufficient extent unless it provides:—

1. A simple method of procedure by which schemes after being examined and approved by county councils may be sanctioned by certificate or license of the Board of Trade.
2. A cheap and simple provision for the compulsory acquirement of necessary land.
3. That no deposit shall be required until the lines have been authorised, and notice has been given to the county council that the work of construction is about to commence.
4. That the opposition of owners and frontagers shall not prevent examination of any scheme by the county councils or the Board of Trade on merits.
5. Optional powers to county councils to construct or to aid in the construction.

(Signed) SAMUEL STOREY.

W. J. CARRUTHERS-WAIN.

STEPHEN SELLON.

R. MELVILL BEACHCROFT.

F. A. CHANNING.

\* A. C. HUMPHREYS-OWEN.

ALBERT K. ROLLIT.

\* Subject to further consideration of paragraph 3.

## APPENDIX II.

## A BILL TO FACILITATE THE CONSTRUCTION OF LIGHT RAILWAYS IN GREAT BRITAIN.

A.D. 1896.

**B**E it enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:

1.—(1.) For the purpose of facilitating the construction and working of light railways in Great Britain, there shall be established a commission, consisting of three commissioners, to be styled the Light Railway Commissioners, and to be appointed by the President of the Board of Trade.

Establishment of  
Light Railway  
Commission.

(2.) It shall be the duty of the Light Railway Commissioners to carry this Act into effect, and to offer, so far as they are able, every facility for considering and maturing proposals to construct light railways.

(3.) If a vacancy occurs in the office of any of the Light Railway Commissioners by reason of death, resignation, incapacity, or otherwise, the President of the Board of Trade may appoint some other person to fill the vacancy, and so from time to time as occasion may require.

(4.) There shall be paid to one of the Commissioners such salary, not exceeding *one thousand pounds* a year, as the Treasury may direct.

(5.) The Board of Trade may, with the consent of the Treasury as to number and remuneration, appoint and employ such number of officers and persons as they think necessary for the purpose of the execution of the duties of the Light Railway Commissioners under this Act, and may remove any officer or person so appointed or employed.

(6.) *The said salary and remuneration, and all expenses of the Light Railway Commissioners incurred with the sanction of the Treasury in the execution of this Act shall, except so far as provision is made for their payment by or under this Act, be paid out of moneys provided by Parliament.*

(7.) The Commissioners may act by any two of their number.

(8.) The powers of the Light Railway Commissioners shall, unless continued by Parliament, cease on the *thirty-first day of December, one thousand nine hundred and one.*

A.D. 1896.

Application for  
orders author-  
ising light rail-  
ways.

Powers of local  
authorities under  
order.

Loans by  
Treasury.

**2.** An application for an order authorising a light railway under this Act shall be made to the Light Railway Commissioners, and may be made—

- (a) by the council of any county, borough, or district, through any part of which the proposed railway is to pass; or
- (b) by any individual, corporation, or company; or
- (c) jointly by any such councils, individuals, corporations, or companies.

**3.**—(1.) The council of any county, borough, or district may if authorised by an order under this Act—

- (a) undertake themselves to construct and work, or to contract for the construction or working of, the light railway authorised;
- (b) advance to a light railway company, either by way of loan or as part of the share capital of the company, or partly in one way and partly in the other, any amount authorised by the order;
- (c) join any other council or any person or body of persons in doing any of the things above mentioned; and
- (d) do any such other act incidental to any of the things above mentioned as may be authorised by the order.

(2.) Provided that—

- (a) an order authorising a council to undertake to construct and work or to contract for the construction or working of a light railway, or to advance money to a light railway company, shall not be made except on an application by the council made in pursuance of a special resolution passed in manner directed by the First Schedule to this Act; and

- (b) a council shall not construct or work or contract for the construction or working of any light railway wholly or partly outside their area, or advance any money for the purpose of any such railway, except jointly with the council of the outside area, or on proof to the satisfaction of the Board of Trade that such construction, working, or advance is expedient in the interests of the area of the first-mentioned council, and in the event of their so doing, their expenditure shall be so limited by the order as not to exceed such amount as will, in the opinion of the Board of Trade, bear due proportion to the benefit which may be expected to accrue to their area from the construction or working of the railway.

**4.**—(1.) Where the council of any county, borough, or district have advanced or agreed to advance any sum to a light railway company, the Treasury may also agree to make an advance to the company by lending them any sum not exceeding *one quarter* of the total amount required for the purpose of the light railway and not exceeding the amount for the time being advanced by the council.

Provided that the Treasury shall not advance money to a light railway company under this section unless at least *one-half* of the total amount required for the purpose of the light railway is provided by means of share capital, and at least *one-half* of that share capital has been subscribed and paid up by persons other than local authorities.

- (2.) Any loan under this section shall bear interest at the rate of

*three and a half* per centum per annum, and shall be advanced on such conditions as the Treasury determine.

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(3.) Where the Treasury advance money to a light railway company under this section, and the advance by the council to the company is made in whole or part by means of a loan, the loan by the Treasury under this section shall rank pari passu with the loan by the council.

5.—(1.) Where it is certified to the Treasury by the Board of Agriculture that the making of any light railway under this Act would benefit agriculture in any cultivated district, or by the Board of Trade that by the making of any such railway a means of communication would be established between a fishing harbour and a market, but that owing to the exceptional circumstances of the district the railway would not be constructed without special assistance from the State, and the Treasury are satisfied that a railway company existing at the time will construct and work the railway if an advance is made by the Treasury under this section, the Treasury may, subject to the limitation of this Act as to the amount to be expended for the purpose of special advances, agree that the railway be aided out of public money by a special advance under this section.

Provided that—

(a) the Treasury shall not make any such special advance unless they are satisfied that landowners, local authorities, and other persons locally interested have by the free grant of land or otherwise given all reasonable assistance and facilities in their power for the construction of the railway; and

(b) a special advance shall not in any case exceed such portion of the total amount required for the construction of the railway as may be prescribed by rules to be made by the Treasury under this Act; and

(c) where the Treasury agree to make any such special advance as a free grant, the order authorising the railway may make provision as regards any parish that so much of the railway as is in that parish shall not be assessed to any local rate at a higher value than that at which the land occupied by the railway would have been assessed if it had remained in the condition in which it was immediately before it was acquired for the purpose of the railway.

(2.) A special advance under this section may be a free grant or a loan or partly a free grant and partly a loan.

(3.) Any loan for a special advance under this section shall be made on such conditions and at such rate of interest as the Treasury direct.

6.—(1.) The total amount advanced by the Treasury under this Act shall not at any one time exceed *one million pounds*, of which a sum not exceeding *two hundred and fifty thousand pounds* may be expended for the purpose of special advances under this Act.

(2.) The National Debt Commissioners may, out of any money for the time being in their hands on account of savings banks, lend to the Treasury, and the Treasury may borrow from the National Debt Commissioners such money as may be required for the purpose of advances by the Treasury under this Act, on such terms as to interest, sinking fund, and period of repayment (not exceeding *thirty years* from the date

Limitation on amount of advance and provision of money by National Debt Commissioners

A.D. 1896.

Consideration of application by Light Railway Commissioners.

of the loan) as may be agreed on between the National Debt Commissioners and the Treasury.

(3.) *The sums so lent by the National Debt Commissioners shall be repaid out of money provided by Parliament for the purpose, and if and so far as that money is insufficient shall be charged on, and payable out of, the Consolidated Fund, or the growing produce thereof.*

7.—(1.) Where an application for authorising a light railway under this Act is made to the Light Railway Commissioners, those Commissioners shall, in the first instance, satisfy themselves that all reasonable steps have been taken for consulting the local authorities, including road authorities, through whose areas the railway is intended to pass, and of the owners whose land it is proposed to take, and for giving public notice of the application, and shall also themselves by local inquiry or such other means as they think necessary possess themselves of all such information as they may consider material or useful for determining the expediency of granting the application.

(2.) The Commissioners shall before deciding on an application give full opportunity for any objections to the application to be laid before them, and shall consider all such objections, whether made formally or informally.

(3.) If after consideration the Commissioners think that the application should be granted, they shall settle any draft order submitted to them by the applicants for authorising the railway, and see that all such matters (including provisions for the safety of the public and particulars of the land proposed to be taken) are inserted therein, as they think necessary for the proper construction and working of the railway.

(4.) The order of the Light Railway Commissioners shall be provisional only, and shall have no effect until confirmed by the Board of Trade in manner provided by this Act.

Submission of order to Board of Trade for confirmation.

8.—(1.) The Commissioners shall submit any order made by them under this Act to the Board of Trade for confirmation, accompanied by such particulars and plans as may be required by the Board, and shall also make and lay before the Board with the order a report stating the objections which have been made to the application, and the manner in which they have been dealt with, and any other matters in reference to the order which the Commissioners may think fit to insert in the report.

(2.) The Board of Trade shall give public notice of any order so submitted to them in such manner as they think best for giving information thereof to persons interested, and shall also state in the notice that any objections to the confirmation of the order must be lodged with the Board and the date by which those objections must be lodged.

Consideration of order by Board of Trade.

9.—(1.) The Board of Trade shall consider any order submitted to them under this Act for confirmation with special reference to—  
 (a) the expediency of requiring the proposals to be submitted to Parliament; and  
 (b) the safety of the public; and  
 (c) any objection lodged with them in accordance with this Act.

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(2.) The Light Railway Commissioners shall, so far as they are able, give to the Board of Trade any information or assistance which may be required by the Board for the purpose of considering any order submitted to them or any objection thereto.

(3.) If the Board of Trade on such consideration are of opinion that by reason of the magnitude of the proposed undertaking, or of the effect thereof on the undertaking of any company existing at the time, or for any other special reason relating to the undertaking, the proposals of the promoters ought to be submitted to Parliament, they shall not confirm the order.

(4.) The Board of Trade shall modify the provisions of the order for ensuring the safety of the public in such manner as they consider requisite or expedient.

(5.) If any objection to the order is lodged with the Board of Trade and not withdrawn, the Board of Trade shall consider the objection, and if after consideration they decide that the objection should be upheld, the Board shall not confirm the order, or shall modify the order so as to remove the objection.

(6.) The Board of Trade may at any time, if they think fit, remit the order to the Light Railway Commissioners for further consideration.

**10.** The Board of Trade may confirm the order with or without modifications as the case may require, and an order so confirmed shall have effect as if enacted by Parliament, and shall be conclusive evidence that all the requirements of this Act in respect of proceedings required to be taken before the making of the Order have been complied with.

**11.** An order under this Act may contain provisions consistent with this Act for—

- (a) the incorporation, subject to such exceptions and variations as may be mentioned in the order, of all or any of the provisions of the Clauses Acts as defined by this Act; and
- (b) the application, if and so far as may be considered necessary, of any of the enactments mentioned in the Second Schedule to this Act (being enactments imposing obligations on railway companies with respect to the safety of the public and other matters); and
- (c) giving the necessary powers for constructing and working the railway, including power to make agreements with railway and other companies for the purpose; and
- (d) the constitution, as a body corporate of a company for the purpose of carrying out the objects of the order; and
- (e) the representation on the managing body of the railway of any council who advance, or agree to advance, any money for the purpose of the railway; and
- (f) authorising a council to advance or borrow money for the purposes of the railway and limiting the amount to be so advanced or borrowed, and regulating the terms on which any money is to be so advanced or borrowed; and
- (g) the manner in which the profits are to be divided, where an

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advance is made by a council to a light railway company as part of the share capital of the company; and

(h) the proper audit of the accounts of the managing body of the railway where the managing body is not a local authority; and

(i) fixing the maximum rates and charges for traffic; and

(j) empowering any local authority to acquire the railway; and

(k) any other matters, whether similar to the above or not, which may be considered ancillary to the objects of the order or expedient for carrying those objects into effect.

Application of  
general Railway  
Acts.

**12.**—(1.) The Clauses Acts, as defined by this Act, and the enactments mentioned in the Second Schedule to this Act, shall not apply to a light railway authorised under this Act except so far as they are incorporated or applied by the order authorising the railway.

13 & 14 Vict.  
c. xxxiii.

(2.) Subject to the foregoing provisions of this Act and to any special provisions contained in the order authorising the railway the general enactments relating to railways (including the Railway Clearing Act, 1850), shall apply to a light railway under this Act in like manner as they apply to any other railway; and for the purposes of those enactments the light railway company shall be deemed a railway company, and the order under this Act a special Act, and any provision thereof a special enactment.

Mode of settling  
purchase money  
and compensa-  
tion for taking of  
land.

**13.**—(1.) Where any order under this Act incorporates the Lands Clauses Acts, any matter which under those Acts may be determined by the verdict of a jury, by arbitration, or by two justices, shall for the purposes of the order be referred to and determined by a single arbitrator appointed by the Board of Trade, and the provisions of this Act shall apply with respect to the determination of any such matter in lieu of those of the Lands Clauses Acts relating thereto.

(2.) The Board of Trade may, with the concurrence of the Lord Chancellor, make rules fixing a scale of costs to be applicable on any such arbitration, and may, by such rules, limit the cases in which counsel are to be allowed.

(3.) The Arbitration Act, 1889, shall apply to any arbitration under this section.

52 & 53 Vict.  
c. 49.  
Provisions as to  
Board of Trade.  
37 & 38 Vict.  
c. 40.

**14.**—(1.) If the Board of Trade hold a local inquiry for the purposes of this Act, Part I. of the Board of Trade Arbitrations, &c. Act, 1874, shall apply to any inquiry so held as if—

(a) the inquiry was held on an application made in pursuance of a special Act; and

(b) the parties making the application for the order authorising the light railway, and in the case of an inquiry held with reference to an objection made to any such application the persons making the objection in addition were parties to the application within the meaning of section three of the Act.

(2.) The Board of Trade may make such rules as they think necessary for regulating the time within which objections must be made, the manner in which any notice under this Act must be given, and any other matters which they may think expedient to regulate by rule for the purpose of carrying this Act into effect.

(3.) There shall be charged in respect of proceedings under this

Act before the Board of Trade or the Light Railway Commissioners such fees as may be fixed by the Treasury on the recommendation of the Board of Trade.

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(4.) *Any expenses of the Board of Trade under this Act shall, except so far as provision is made for their payment by or under this Act, be defrayed out of moneys provided by Parliament.*

(5.) The Board of Trade shall present to Parliament annually a report of their proceedings and of the proceedings of the Light Railway Commissioners under this Act.

**15.**—(1.) The council of any county, borough, or district may pay <sup>Expenses of</sup> local authorities. any expenses incurred by them and allowed by the Light Railway Commissioners with reference to any application for an order authorising a light railway under this Act, in the case of a county council as general expenses, in the case of a borough council out of the borough fund or rate, and in the case of a district council as general expenses under the Public Health Acts.

Provided that any such expenses and any expenses payable in like manner under this Act if incurred by a county council may be declared by the order authorising the railway or, in the event of an unsuccessful application for such an order, by the Light Railway Commissioners, to be exclusively chargeable on certain parishes only in the county, and those expenses shall be levied accordingly as expenses for a special county purpose under the Local Government <sup>51 & 52 Vict.</sup> <sub>c. 41.</sub> Act, 1888.

(2.) Where the council of any county, borough, or district are authorised to expend any money by an order authorising a light railway under this Act, they may raise the money required,—

- (a) if the expenditure is capital expenditure, by borrowing in manner authorised by the order; and
- (b) if the expenditure is not capital expenditure, as if it was on account of the expenses of an application under this Act.

(3.) The Board of Trade may from time to time on the application of any council extend, subject to the limitations of this Act, the limit of the amount which the council are authorised by an order under this Act to borrow, or to advance to a light railway company, and the limit so extended shall be substituted for the limit fixed by the order.

(4.) Where an order under this Act authorises any council to borrow for the purposes of a light railway, suitable provision shall be made in the order for requiring the replacement of the money borrowed within a fixed period not exceeding *sixty years*, either by means of a sinking fund or otherwise.

(5.) Any profits made by a council in respect of a light railway shall be applied in aid of the rate out of which the expenses of the council in respect of the light railway are payable.

**16.**—(1.) The councils of any county, borough, or district may <sup>Joint com-</sup> <sub>mittees.</sub> appoint a joint committee for the purpose of any application for an order authorising a light railway under this Act, or for the joint construction or working of a light railway, or for any other purpose in connexion with such a railway for which it is convenient that those councils should combine.

A.D. 1896.

51 & 52 Vict.  
c. 41.  
56 & 57 Vict.  
c. 73.Working of  
ordinary railway  
as light railway.Amendment of  
order.Application to  
Scotland.52 & 53 Vict.  
c. 50.

(2.) The provisions of the Local Government Act, 1888, or of the Local Government Act, 1894, as the case may be, with respect to joint committees, shall apply to any joint committee appointed for the purpose of this Act by any councils who could appoint a joint committee under those Acts, but where the councils have no power under those Acts to appoint a joint committee the provisions in the Third Schedule to this Act shall apply.

**17.** Where a company have power to construct or work a railway, they may be authorised by an order under this Act to construct and work or to work the railway or any part of it as a light railway under this Act.

**18.** An order authorising a light railway under this Act may be altered or added to by an amending order made in like manner and subject to the like provisions as the original order.

Provided that—

- (a) the amending order may be made on the application of any authority or person; and
- (b) the Board of Trade, in considering the expediency of requiring the proposals for amending the order to be submitted to Parliament, shall have regard to the scope and provisions of the original order.

**19.** This Act shall apply to Scotland with the following modifications:—

(1.) The Secretary for Scotland shall be substituted for the Board of Agriculture;

(2.) References to the council of any county, borough, or district shall be construed as references to the county council of any county, or the town council, or where there is no town council the police commissioners of any burgh;

(3.) "Arbiter" shall be substituted for "arbitrator," and that arbiter shall be deemed to be a single arbiter within the meaning of the Lands Clauses Consolidation (Scotland) Act, 1845, and the Acts amending the same, and the provisions of those Acts with respect to an arbitration shall apply accordingly, in lieu of the provisions of the Arbitration Act, 1889;

(4.) The Lord President of the Court of Session shall be substituted for the Lord Chancellor;

(5.) The provisions relating to district councils shall not apply;

(6.) "General purposes rate" and "burgh general assessment" shall be substituted for "general expenses" and "borough fund or rate" respectively;

(7.) The expression "Clauses Acts" shall mean the Land Clauses Acts, the Railway Clauses Consolidation (Scotland) Act, 1845, the Companies Clauses Consolidation (Scotland) Act, 1845, the Companies Clauses Act, 1863, the Railways Clauses Act, 1863, and the Companies Clauses Act, 1869;

(8.) Where under this Act expenses are chargeable upon certain parishes only, those expenses shall be levied and collected within the parishes chargeable in the same manner as the general purposes rate under the Local Government (Scotland) Act, 1889;

(9.) References to the Local Government Act, 1888, and the Local Government Act, 1894, shall be construed as references to the Local Government (Scotland) Act, 1889.	A.D. 1896. 52 & 53 Vict. c. 50.
<b>20.</b> This Act shall not extend to Ireland.	Extent of Act.
<b>21.</b> In this Act, unless context otherwise requires,— The expression "light railway company" includes any person or body of persons, whether incorporated or not, who are owners or lessees of any light railway authorised by this Act, or who are working the same under any working agreement.	Definitions.
The expression "Clauses Acts" means the Lands Clauses Acts, the Railways Clauses Consolidation Act, 1845, and the Railways Clauses Act, 1863, and the Companies Clauses Acts, 1845 to 1889.	
The expression "share capital" includes any capital, whether consisting of shares or of stock, which is not raised by means of borrowing.	
<b>22.</b> This Act may be cited as the Light Railways Act, 1896.	Short title.

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## SCHEDULES.

### FIRST SCHEDULE.

#### MODE OF PASSING SPECIAL RESOLUTIONS.

1. The resolution approving of the intention to make the application must be made at a special meeting of the council.
2. The special meeting shall not be held unless a month's previous notice of the meeting, and of the purpose thereof, has been given in manner in which notices of meetings of the council are usually given.
3. The resolution shall not be passed unless two-thirds of the members of the council are present and vote at the special meeting, and a majority of those present and voting concur in the resolution.

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A.D. 1896.

## SECOND SCHEDULE.

## ENACTMENTS RELATING TO SAFETY, &amp;c.

Session and Chapter.	Title or Short Title.	Enactment referred to.
2 & 3 Vict. c. 45.	An Act to amend an Act of the fifth and sixth years of the reign of his late Majesty King William the Fourth relating to highways.	The whole Act.
5 & 6 Vict. c. 55.	The Railway Regulation Act, 1842.	Sections four, five, six, nine, ten.
9 & 10 Vict. c. 57.	An Act for regulating the gauge of railways.	The whole Act.
31 & 32 Vict. c. 119.	The Regulation of Railways Act, 1868.	Sections nineteen, twenty, twenty - two, twenty - seven, twenty - eight, and twenty - nine.
34 & 35 Vict. c. 78.	The Regulation of Railways Act, 1871.	Section five.
36 & 37 Vict. c. 76.	The Railway Regulation Act (Returns of signal arrangements, working, etc.), 1873.	Sections four and six.
41 & 42 Vict. c. 20.	The Railway Returns (Continuous Brakes) Act, 1878.	The whole Act.
46 & 47 Vict. c. 34.	The Cheap Trains Act, 1883.	Section three.
52 & 53 Vict. c. 57.	The Regulation of Railways Act, 1889.	The whole Act.

## THIRD SCHEDULE.

A.D. 1896.

## JOINT COMMITTEES.

- (a.) Any council taking part in the appointment of a joint committee may delegate to the committee any power which the council may exercise for the purpose for which the committee is appointed.
- (b.) A council shall not be authorised to delegate to a joint committee any power of making a rate or borrowing money.
- (c.) Subject to the terms of the delegation the joint committee shall have the same power in all respects with respect to any matter delegated to them, as the councils appointing it or any of them.
- (d.) The members of the joint committee may be appointed at such times and in such manner, and shall hold office for such period, as may be fixed by the councils appointing them :  
Provided that a member shall not hold office beyond the expiration of fourteen days after the day for the ordinary election of councillors of the council by which he was appointed.
- (e.) The costs of a joint committee shall be defrayed by the councils by whom the committee is appointed, in such proportions as they may agree upon.
- (f.) When any of the councils joining in the appointment of a joint committee is a county or district council, the accounts of the joint committee shall be audited in like manner and with the like power to the officer auditing the accounts, and with the like incidents and consequences as the accounts of a county council.
- (g.) The chairman at any meeting of the committee shall have a second or casting vote.
- (h.) The quorum, proceedings, and place of meeting of a committee, whether within or without the area within which the committee are to exercise their authority, shall be such as may be determined by regulations jointly made by the councils appointing the committee.
- (i.) Subject to those regulations the quorum, proceedings, and place of meeting, whether within or without the area within which the committee are to exercise their jurisdiction, shall be such as the committee direct.

## APPENDIX III.

## CAPE OF GOOD HOPE.

## BILL TO PROVIDE FOR THE CONSTRUCTION AND EQUIPMENT OF CERTAIN LINES OF RAILWAY.

*(Introduced by Select Committee.)*

## Preamble.

BE it enacted by the Governor of the Cape of Good Hope, with the advice and consent of the Legislative Council and House of Assembly thereof, as follows:—

1. In this Act the following terms shall have the following meanings, unless any such meaning shall be inconsistent with the context:

“Company” shall mean any Company duly registered in this Colony in accordance with law;

“Concessionary” shall mean any Company or person who shall by any agreement under this Act undertake for the payment of a subsidy by the Governor, the construction of any line of railway authorised by this Act;

“Contractor” shall mean any Company or person who shall by any agreement undertake to the Governor to construct any line of railway authorised by this Act to be constructed by the Governor.

2. The following lines of light railway shall be constructed under the provisions of this Act upon the gauge at present in general use in this Colony:—

(1) A line of railway from Mossel Bay, *via* George, Oudtshoorn and Willowmore, to a point on the Graaff-Reinet Railway, at or near Klipplaat;

(2) A line of railway from a point, at or near Somerset East, *via* Cookhouse and Bedford, to Fort Beaufort;

(3) A line of railway from Fort Beaufort, *via* Alice, to King William’s Town;

(4) A line of railway from Graaf Reinet, *via* Middelburg, to Middelburg Road.

3. As soon as conveniently may be after the passing of this Act the Governor shall by public advertisements in this Colony and in England call for offers for the construction of the several lines of railway numbered (1), (2), and (3) in the last preceding section upon terms

Governor to call  
for offers for  
construction of  
lines 1, 2, and 3.

and conditions to be framed in accordance with the provisions of this Act.

**4.** Such offers shall be sent in, in writing, to the General Manager How offers to be made and when. of Railways or to such other person as the Commissioner may appoint to receive the same on or before a date to be stated in such advertisements as aforesaid, not being in any case a date later than the first day of March, 1896.

**5.** Every offer sent in as aforesaid shall state what percentage, not exceeding forty per cent. of the actual cost of construction as determined under this Act and what sum not exceeding one thousand five hundred pounds sterling per mile, for all lines save and except the section of the line from Mossel Bay to Oudtshoorn, and what sum not exceeding two thousand pounds per mile for the said section, the Company or person making the offer will, in accordance with the provisions of this Act and relative agreement, agree to accept by way of subsidy from the Governor for and in respect of the construction of the line or lines of railway to which such offer refers: provided that in calling for tenders for the construction of the line from Mossel Bay to Klipplaat, the same shall be invited not only for the whole line but also for two distinct and separate sections, viz.: (1) Mossel Bay to Oudtshoorn, and (2) Oudtshoorn to Klipplaat.

**6.** The general terms and conditions to be inserted in any agreement entered into with any concessionary shall be set forth in such advertisement, and shall be framed in accordance with the provisions of this Act, but as to the details of specifications, route, and other matters relating to the construction of any of the said lines it shall be sufficient in any such advertisement to set forth that the same may be inspected or ascertained at the office of the General Manager of Railways or such other place as the Commissioner may appoint.

**7.** The terms and conditions shall be fixed by the Governor, and shall, amongst others, make provision to secure the following objects:

(a) That good and substantial security to the satisfaction of the Governor shall be given by every concessionary for the due completion of the line in respect of which his offer is accepted;

(b) that a substantial sum, not being less than £1000 sterling in any case, shall be deposited with the Commissioner by every company or person making an offer on or before the date when such offer is sent in, which sum shall be returned if such offer is not accepted, or in case such offer be accepted, and good and substantial security be given; but shall be forfeited in case such offer be accepted, but the concessionary shall fail thereafter to comply with the condition as to good and substantial security;

(c) that the subsidy agreed upon shall be payable upon the due completion of such sections of the said lines respectively, as the Governor shall determine, and as shall be stated in such advertisement;

(d) that the amount of actual cost incurred in respect of the construction of any section or line shall be ascertained either by the certificate of a Government engineer appointed for the

Conditions as to percentage or subsidy required by persons making offer.

General terms and conditions to be set forth.

What general terms and conditions amongst others, shall be contained in any offer.

purpose, or in such manner and upon production of such proofs as the Governor shall approve, and that the total amount of the subsidy shall be computed upon the actual cost of the entire line in respect of which the offer of any concessionary is accepted, including the cost of such bridges, culverts, tunnels, stations or other fixed appurtenances of the line as the Governor shall approve;

- (e) that at any time after the expiration of twelve years from the date of the acceptance of any offer, it shall be lawful for the Governor, with the authority of both Houses of Parliament, and after giving at least six months' notice, to purchase and take possession of any line undertaken by any concessionary under the provisions of this Act, the purchase price to be the amount of the actual cost determined as aforesaid, with the addition of ten per cent. and the deduction of an amount for wear and tear to be determined, in case of difference, by arbitration, credit to be taken in the account for all amounts paid by way of subsidy;
- (f) that the tariffs of fares for passengers and rates for goods, produce, live-stock, and vehicles, shall be reasonable tariffs, subject to the approval of the Governor, and shall after settlement be liable to be re-adjusted by the concessionary from time to time with the like approval, at the request of the Governor, acting upon a resolution of both Houses of Parliament; and that the tolls, fares, or rates of charge to be taken or made for passengers shall be at all times charged equally to all persons, and after the same rate in respect of all passengers travelling under the same conditions; and the tolls, fares, or rates of charge to be taken or made for goods shall be likewise charged equally after the same rate, whether by ton or otherwise, in respect of all goods of the same description; and no reduction or advance in any such tolls, fares or rates, shall be made either directly or indirectly in favour of or against any particular company or person travelling upon or using the said railway;
- (g) that reasonable arrangements conferring on the Government running powers and providing facilities for through traffic, shall be made as between the concessionaries of each line and the Colonial Government, and also similar arrangements as between different concessionaries in respect of the various subsidised lines;
- (h) that the line shall be commenced and completed within periods to be determined in each agreement, each line to be, however, completed within four years from the date of the taking effect of this Act, unless the Governor shall for special reasons extend the said period with the authority of both Houses of Parliament;
- (i) that in the event of the insolvency or liquidation of any person or company being concessionary of any line, the Governor shall be entitled then to exercise, without notice, the option provided by sub-section (e) to purchase the said line, and in the event

of the said option not being exercised, and the line being disposed of, the purchaser shall be liable to all the conditions of the agreement with the concessionary, save in so far as the same may be modified with the consent of the Governor.

**8.** It shall be lawful for the Governor before the completion of any section of any line to make payments in advance upon the provisional certificates of a Government engineer appointed for the purpose certifying to the actual cost of the work then done upon such section; Provisions as to payment by the Government of percentage or subsidy agreed upon. provided that the amounts so advanced shall in no case exceed either forty per cent. of the actual cost so provisionally certified, or, as the case may be, the sum of two thousand pounds or one thousand five hundred pounds sterling per mile of the portion of such section then completed.

**9.** If and when any offer for the construction of any of the said four lines has been accepted by the Governor, and good and substantial security has been given for the due completion of the line, a formal agreement shall be executed embodying the terms and conditions upon which the concessionary may undertake the construction of such line. Formal agreement to be executed.

**10.** If no satisfactory agreement shall be entered into relative to the construction of line (1) aforesaid, or relative, in accordance with the preceding sections three to nine inclusive, to the construction of the portion of line (1), one hundred and fifty-four miles in length, from Oudtshoorn *via* Willowmore to the point hereinafter mentioned, the Governor shall cause the portion of the said line from Oudtshoorn *via* Willowmore, to a point on the Cape Government Railway at or near Klipplat to be constructed and equipped in accordance with the following provisions of this Act. Provision for construction by the Government of line (1) in case no agreement shall be entered into.

**11.** In either event contemplated in the last preceding section as to line (1) aforesaid, and as soon as conveniently may be after the passing of this Act as to line (4) aforesaid, the Governor shall cause the aforesaid portion of line (1) and the said line (4) to be constructed and equipped, and shall for that purpose call for tenders for the construction of each of the said lines by contractors who shall have the powers conferred by this Act in relation to the construction of the said lines. Construction by Government, if and when determined on, to be by public tender by contractors.

**12.** The cost of the construction and equipment of the aforesaid portion of line (1) shall not exceed £650,000, and of the line (4) Maximum cost of lines (1) and (4). aforesaid shall not exceed £446,000.

**13.** For the purposes of this Act, that is to say, for the provision of funds to meet the amount required from time to time for the payment of subsidies and for the construction of the lines of railway authorised to be constructed by contractors under this Act, the Governor shall raise by loan amounts not exceeding the several sums specified in Schedule A to this Act, and the cost incurred in raising any such loan, including discount, if any, commission, and other incidental charges, shall be a first charge against the amount of such loan. Governor authorised to raise loans to provide funds for construction of lines under this Act.

**14.** The route of the several lines of railway authorised by this Act or any part of any such line may be surveyed in detail by such persons as the Governor may appoint, and the details of the route Surveys to be made and approved before the work is commenced.

of any section of any such line as shown by the working plans and sections thereof shall be approved by the Governor before the work in such section is commenced.

**Power of entry upon land, provision for compensation for damage done, by means of arbitration.**

**15.** For the purpose of setting out any line of railway authorised by this Act, the Governor and the concessionary, or the contractor, as the case may be, may by persons thereto duly authorised in writing, enter upon any land for the purpose of surveying the same and of probing and boring in order to ascertain the nature and formation of the soil, making full compensation to the occupier of the said land for any damage thereby occasioned, such compensation to be, within three months from the date when such damage is alleged to have been sustained, recovered, in case the amount is not settled by consent, either by arbitration if that course be mutually agreed upon or by action in some competent court.

**Power of entry on and possession of waste Crown land under this Act.**

**16.** The concessionary or contractor, as the case may be, may with the permission of the Governor enter upon and take possession of and hold and retain for the purposes of this Act, free of charge, so much of any Waste Crown land as shall be required for the construction and maintenance of any line of railway authorised by this Act, or for any other purpose relating to the due execution of this Act, or of any agreement between the Governor and such concessionary or contractor, and may with the like permission, and free of charge, enter upon any such land lying convenient to such line of railway and there dig for, excavate, and carry away all stones, clay, or other materials required for any of the purposes aforesaid: Provided

(a) that nothing herein contained shall be construed to establish any servitude in favour of such concessionary upon any such land, not being land reasonably required for the actual working of the railway, which may hereafter be sold or leased by the Colonial Government to any purchaser or lessee; and (b) That the term "Waste Crown Land" shall not be taken to include any land that has been or may be acquired by the Colonial Government by purchase or otherwise for any special purpose.

**Provisions of §§ 146 and 147 of Act No. 40 of 1889, to apply to concessionary or contractor under this Act.**

**17.** The concessionary, in respect of every subsidised line authorised by this Act and the Governor, in respect of every line authorised by this Act to be constructed by a contractor, shall for the purpose of the construction and maintenance of the several lines of railway authorised by this Act, and for any other purpose relating to the due execution of this Act, or of any agreement between the Governor and any concessionary or contractor, have and exercise all the rights and powers, subject to all the duties and obligations which a Divisional Council by law has and exercises or is subject to under sections one hundred and forty-six and one hundred and forty-seven of the Act No. 40 of 1889, for the purposes set forth in section one hundred and forty-one of the said Act: Provided

(a) that the extent of the land taken for any line of railway shall not exceed fifty feet for the formation line, together with such sufficient additional land as may be required for the slopes, drainage, stations, approach roads, and all other works,

matters and things which may be requisite or necessary for the efficient construction and maintenance and working of such railways;

(b) that publication of notice in the *Gazette* shall be deemed to be sufficient notice to any proprietor who shall be absent from the Colony or whose place of residence shall not be known;

(c) that the settlement of questions as to recompense or compensation in consequence of any exercise of the rights and powers aforesaid shall not delay such exercise, and such questions shall, as soon as may be, be determined under the Lands and Arbitrations Clauses Act, 1882.

**18.** The provisions of sections one hundred and fifty-three, one hundred and fifty-four, two hundred and four, and two hundred and five of the Act No. 40 of 1889, shall apply *mutatis mutandis* in respect of the several lines of railway authorised by this Act, as though the said lines were public roads, the Governor or the concessionary, as the case may be, being deemed and taken to be referred to in the said sections in place and stead of the Divisional Council.

Provisions of  
§§ 153, 154, 204  
and 205, of Act  
40 of 1889, to  
apply.

**19.** At all places where the line of any railway authorised by this Act shall intersect or cross the line of any street or road, it shall be lawful for the concessionary or the contractor, as the case may be, to make and carry such line of railway across such street or road either by means of a level crossing or by means of a convenient and sufficient bridge or viaduct over or under the said street or road, and such concessionary or contractor shall make all such cuttings, embankments and approaches with all such culverts and drains and all such repairs as may be requisite to make good the street or road across or over or under the said railway at gradients not exceeding one foot in twenty feet, and shall also maintain and keep in repair all such crossings, bridges, viaducts, cuttings, embankments, approaches, culverts and drains as aforesaid.

Powers in regard  
to streets or  
roads crossed or  
intersected by  
lines authorised  
under this Act.

**20.** Nothing in this Act contained shall prevent the construction, in accordance with law, of any public road crossing any line of railway authorised by this Act at a suitable and convenient place approved of by the Governor, provided that all damage occasioned by the construction of such road shall be made good by the public authority constructing the same.

Power, with  
Governor's  
approval, of con-  
struction of  
public roads  
across any line  
authorised by  
this Act.

**21.** No line of railway constructed by any concessionary under this Act, and no portion of any such line, shall be opened for traffic until the Governor shall be satisfied by the certificate of a Government engineer appointed for the purpose, that such line, or the portion thereof, is sufficiently completed for the safe conveyance of passengers.

No line shall be  
opened for traffic  
without  
Governor's  
sanction.

**22.** The provisions of Act No. 19 of 1861, entitled "The Regulation of Railways Act, 1861," and of any law now or hereafter amending the said Act, shall apply to every concessionary and the line of railway constructed by such concessionary, and shall also, save as to sections twenty-nine and thirty of the said Act, and any amendments of the said sections, likewise apply *mutatis mutandis* to the Governor, and to any line of railway constructed by any contractor under this Act.

How far pro-  
visions of Act 19  
of 1861 are to  
apply.

Power to construct, erect and work Telegraph or Telephone along lines of Railway.

Provisions of Lands and Arbitrations Act, 1882, to apply.

Gauge, etc., to be same as that of Colonial Government Railways.

Effect and Short Title.

**23.** Every concessionary may construct, erect and work, for the purposes of the line of railway undertaken by such concessionary, but for no other purpose, a telegraph and telephone, or either, along or near such line of railway, subject always to the provisions of Act No. 20 of 1861, commonly called "The Electric Telegraph Act, 1861," and of any law now or hereafter amending the said Act.

**24.** The provisions of the "Lands and Arbitrations Clauses Act, 1882," shall apply to all arbitrations arising under any provisions of this Act, or under any agreement contemplated by this Act.

**25.** The lines of light railway authorised by this Act shall, as to the gauge and in general, be similar to the lines of railway now in use and forming the Colonial Government Railways, save that in the construction the particulars set forth in Schedule B to this Act shall be as far as possible observed.

**26.** This Act shall take effect forthwith upon its promulgation, and may be cited for all purposes as "The Railways Extension Act, 1895."

#### SCHEDULE A.

(1) For providing a subsidy for the line from Mossel Bay <i>via</i> George, Oudtshoorn, and Willowmore to a point on the Graaff-Reinet Railway at or near Klipplaat	...     ...	£375,000
(2) For providing a subsidy for the line from Somerset <i>via</i> Cookhouse and Bedford to Fort Beaufort	...     ...	£116,250
(3) For providing a subsidy for the line from Fort Beaufort <i>via</i> Alice to King William's Town	...     ...	£82,500
(4) For the construction of the line from Oudtshoorn <i>via</i> Willowmore to a point on the Graaff-Reinet Railway at or near Klipplaat, in case no concessionary shall undertake the construction of line (1), in which event the above amount of £375,000 will not be required, or of the line aforesaid from Oudtshoorn to Klipplaat, in which event the amount of £231,000, portion of the said amount of £375,000, will not be required	...     ...	£650,000
(5) For the construction of a line from Graaff-Reinet <i>via</i> Middelburg to Middelburg Road	...     ...	£446,000

#### SCHEDULE B.

##### PARTICULARS FOR RAILWAY CONSTRUCTION UNDER THIS ACT.

- (1) Embankments—
  - (a) under 10 feet high, to be 12 feet wide, but not less, at the top;
  - (b) 10 feet high or more, to be 14 feet wide, but not less, at the top.
- (2) Formation in cuttings, exclusive of width required for side drains, to be 14 feet, but not less, at the bottom.

- (3) Ballasting to be 12 inches in depth, but not less save where the Government Engineer shall certify that the formation will permit of reduction.
- (4) Permanent way to consist of steel rails of  $46\frac{1}{4}$  lbs. to the yard; if heavier rails be laid concessionary to bear extra cost.
- (5) Sleepers to be of steel, iron, or wood—
  - (a) spaced on an average to the number of not less than 1760 per mile;
  - (b) at the joints of rails to be 2 feet 6 inches apart from centre to centre;
  - (c) if of wood, to be 6 feet 6 inches long, 9 inches wide, and  $4\frac{1}{2}$  inches deep, but not of less dimensions;
  - (d) if of iron or steel, the design to be approved by the Government Engineer.

## APPENDIX IV.

## LAND-GRANT BILL FOR RAILWAYS IN QUEENSLAND.\*

## SUMMARISED PROVISIONS OF THE BILL.

The bill "To make provision for the construction of railways by joint-stock companies, and to authorize grants of Crown lands in aid of such construction," which has occupied the attention of the House more or less since the 14th of April last, when it was introduced and read a first time in the Legislative Assembly, on Wednesday week emerged from committee and passed its third reading on the following day. As the bill has been considerably altered since it was first introduced into the House, we append herewith a synopsis of the main provisions of the bill as it is now framed:—

*Terms of Contract.*

The first two clauses are of a formal character, and clause 3, which determines that a Minister may make contracts for the construction of railways by companies, remains unaltered.

4. The contract may provide for the construction of a railway on any of the following conditions: (1) On the condition that the railway shall be and remain the property of the company for a fixed period not exceeding fifty years, and shall then become the property of the Crown; (2) on the condition that the railway shall become the property of the Crown as soon as it is constructed; (3) on the condition that the railway shall be and remain the property of the company subject to a right of purchase by the Crown within a time and upon terms to be defined by the contract.

5. Subject to the provisions of this Act, the contract may provide that the company shall receive by way of payment or subsidy for the construction of the railway, grants in fee simple of Crown lands of a value to be specified in the contract.

6. When the Governor-in-General thinks it desirable that a railway should be constructed, and that Crown lands should be granted by way of subsidy for its construction, he may, by proclamation, reserve and set apart for the purpose of the subsidy a sufficient area of Crown lands adjacent to the line of the proposed railway to provide for the land so to be granted, and also to provide for the alternate choice directed by this Act. If practicable, the reservation shall be of lands on both sides of the line of the proposed railway, and as nearly as may be in equal areas on each side, but if there is not any land, or if there is not sufficient land, of a suitable character on either side, the whole may be reserved on one side.

7. The area of land that may be granted to a company by way of subsidy for the construction of a railway shall be determined as follows:—The value of the land reserved and proposed to be granted shall be assessed by the Governor-in-Council, and shall be estimated at the fair market value of the land immediately before the making of the contract, and without regard to any prospective value that may be given to the land by reason of the construction of the proposed railway. The value of the land that may be granted to the company shall be proportional to the actual cost of construction of the railway, and shall not exceed the proportions following:—(1) If the railway is to become the property of the Crown at the expiration of a fixed period, a sum equal to twice the cost of construction; (2) If the railway is to become the property of the Crown as soon as it is constructed, or if the railway is to remain the property of the company subject to a right of purchase by the Crown, a sum equal to the cost of construction. For the purposes of this section the maximum cost of construction shall be fixed and defined by the contract between the Minister and the company, and the company shall not be entitled to any larger subsidy if the cost so fixed and defined is in fact exceeded.

8. When a contract has become binding under this Act, the lands reserved for the purpose of the subsidy for the railway constructed under the contract shall be forthwith surveyed and divided into convenient blocks separated by roads, and, as nearly as may be, of equal value. Such blocks shall be rectangular, except in cases in which it is desirable in order to secure natural boundaries to make them of another shape, but where the shape is so varied a block shall not have a greater frontage to a water-course than one-half of its depth. No block shall have a greater frontage to the railway than ten miles, and the frontage of a block to the railway shall not exceed its depth. The total frontage to the railway of the land granted to the company shall in no case exceed one-half of the frontage on either side.

Clause 9 provides that before a company begins the construction of a railway it must be proved that it has a capital subscribed in good faith and by responsible persons of £1000 for every mile of line, and a paid-up capital actually available for the construction of the railway of not less than one-fifth of such subscribed capital.

Under clause 10, railway works partially made, and works for the reclamation of land from the sea, may be included in the contract, and land so reclaimed may be granted to the company.

Clause 11 provides that before a contract is made a plan of the railway showing generally its line and direction, and an estimate of the cost of the railway and its equipment, certified by some competent engineer, shall be supplied for the information of the Governor-in-Council.

Under clause 12 the Minister may require from the company such further information as he may deem necessary.

Clause 13 provides for the publication in the "Government Gazette" of a notice setting forth particulars of any contract entered into under the Act.

#### *Ratification of Contracts.*

Clause 14 provides that a copy of every contract made under the Act shall be laid before both Houses of Parliament during the session in which it is made, or if it is not made during a session, then during the next session after the making of the contract, and shall lie upon the table of each House for fourteen days. If after the expiration of such period of fourteen days both Houses adopt addresses to the Governor approving of the contract, the contract shall become binding. Until such addresses

have been adopted by both Houses the contract shall be deemed to be a provisional contract only.

Clause 15 provides that, before a copy of the contract has been so laid before Parliament, the Governor-in-Council may by Order-in-Council authorize the company (1) to make the necessary surveys for the railway, and for that purpose to enter upon any public or private lands along the line of the intended railway; and (2) to take all other necessary preliminary steps for the future construction of the railway. When an Order-in-Council is made under this section, a company which avails itself of the order shall have the same rights and powers, and be subject to the same liabilities so far as regards the exercise of the powers so conferred, as if the contract had become binding.

Clause 16 provides that should the contract be annulled by Parliament, the company is to be entitled to receive from the Crown the cost of necessary surveys and examination of route.

*Grants of Land.*

17. When a contract has been made under the Act for the construction of a railway, or for the construction and working of a railway, and for the granting of land by way of subsidy for such construction or construction and working, if the Minister is satisfied that the whole line has been well and faithfully constructed under the provisions of this Act, and in accordance with the contract and the plans and specifications forming part thereof, and that the same is complete and fully equipped and fit for public traffic, the company shall be entitled to select from the land reserved and set apart for the purpose of the subsidy for that railway, the land to be granted to the company under the contract. If the Minister is satisfied that any section of the railway which can be usefully worked for public traffic has been so constructed, and is complete and fit for public traffic, the Governor-in-Council may allow the company to select from that part of the land so reserved and set apart, through or along which the completed section passes, an area the value of which as specified in the contract does not exceed nine-tenths of a sum bearing the same proportion to the value of the total area of land to be granted to the company under the contract for the construction of the entire line as the cost of the completed section bears to the cost of the entire line.

18. The selection of the land to be granted to the company shall be made by way of alternate choice by the company and the Minister. The company shall first choose one of the blocks surveyed as hereinbefore provided out of the lands reserved and set apart for the purpose of the subsidy for the railway. Upon the choice of a block by the company, and before the choice of another block by the company, the Minister, or some person appointed by him for the purpose, shall choose a block, which shall be retained by the Crown; and so on, until the company has selected the total area to be granted to it: provided that neither the company nor the Minister shall be entitled to select two contiguous blocks having frontage to the railway.

Clause 19 lays it down that:—(1) Upon the completion of the railway or a section of the railway, as hereinbefore provided, the company shall be entitled to receive grants of a part only of the whole area of the land to be granted to it, but shall be entitled nevertheless to select immediately the whole of the blocks so to be granted. The proportion to be granted immediately shall be such as is prescribed by the contract, but shall not exceed one-half of the whole area; (2) the blocks to be granted immediately shall be selected by the company out of the

whole number of blocks selected by it, the Minister, or other person appointed by the Governor-in-Council as aforesaid, being entitled to choose blocks to be retained and leased as next hereinafter provided in alternation with the company's choice of the blocks to be granted immediately; (3) leases of the remainder of the company's blocks shall be granted to it for the remainder of the fixed period aforesaid at a peppercorn rent, subject to the condition that if the company fails to complete the railway, or if any time during the term of the lease the company makes any default which entitles the Crown to take possession of the railway under this Act, the lease shall be forfeited and the land shall revert to the Crown; and so that the waiver of a forfeiture for any default shall not operate to prevent the enforcement of a forfeiture for any subsequent default of the same kind; provided that any lease from the company of any of the land to a tenant at a rack rent for any term not exceeding seven years shall not be determined by the Crown in consequence of any such forfeiture, but the Crown shall upon such forfeiture be entitled to receive any rents which would have become payable to the company if the lease had not been determined by the Crown. If, at the expiration of the fixed period aforesaid, no such default has been made, the lands comprised in the leases shall be granted to the company in fee-simple.

20. When any land of which the company is entitled to a grant under the Act is in the lawful occupation of any person as a tenant or licensee of the Crown the company shall, before receiving the grant thereof, be required by the Minister either to pay to the owner for the time being the value of the improvements, if any, upon it, to be determined in the manner provided by the Acts under which the land is held, or to select instead of such block an area of available Crown land of equal value within the lands reserved and set apart for the purpose of the railway.

21. Except as hereinbefore provided, Crown grants shall be issued for the blocks to which the company is entitled as soon as conveniently may be after the selection thereof. Every Crown grant issued under the Act shall contain a power to the Governor-in-Council, at any time within ten years from the issue of the grant, to take and lay off for roads or streets through any land comprised in the grant, or to take for State schools, or any other public purpose, and in either case without compensation except for improvements and severance, such part of the land not exceeding one-hundredth part of the whole as the Governor-in-Council may think fit. All other provisions of any Act for the time being in force and generally applicable to grants of land from the Crown shall extend and apply to grants made under this Act.

22. In addition to the grants of land by way of subsidy for construction, the company shall, unless the railway is to become the property of the Crown as soon as it is constructed, or at the expiration of a fixed period, be entitled to a grant of any Crown land on which the line is laid, and of so much Crown land on either side, not exceeding a total width of two chains, as may be specified in the contract, and also to grants of such sites for railway stations, stores, and other buildings connected with or used by the railway, as are reasonably necessary for the purposes of the company and are provided for by the contract.

23. Nothing in the Act shall prejudicially affect any rights or interests acquired by any person in or with respect to any land before the grant of the land to the company, whether such rights or interests have been acquired under the Goldfields Act of 1874, or the Mineral Lands Act of 1882, or in any other manner whatsoever.

*Traffic.*

Clauses 24 to 30 inclusive deal with the matter of traffic. Regulations are to be subject to the approval of the Governor-in-Council, who may from time to time reduce the tolls for the conveyance of passengers and goods, but not (unless with the sanction of the company) below the rate of 2d. per mile for each passenger, and 3d. per mile for each ton of goods. The line to be freely used by every person complying with the regulations. Mails and officers are to be carried free, and members of the Legislature are to enjoy the same privileges as on Government railways. The company are to incur and be bound by the liabilities and obligations of common carriers. Trains are to be run regularly and at such minimum rate of speed as is laid down in the contract. The company are forbidden to show any partiality to any person or to any kind of traffic, or to place any person or kind of traffic at a disadvantage.

*Running Powers.*

Clauses 31 to 33 inclusive provide that the company and the Railway Commissioners are to have running powers over each other's lines; terms to be settled by agreement or by referees to be appointed by a Judge of the Supreme Court. A penalty for refusal to grant such facilities after terms have been so settled at the rate of £100 per day is provided.

*Purchase—Abandonment.*

Clauses 34 to 40 inclusive deal with the power of the Crown to purchase the line and the penalty of abandonment. In cases where it is provided that the line is to be the property of the company, subject to a right of purchase by the Crown, that right may be exercised at any time after the expiration of ten years from the completion of the line, but such purchase is not to include the land granted as a subsidy to the company, the basis of valuation to be specified in the contract. If the value or other sum payable by the Government be not agreed upon, arbitrators are to be appointed, one arbitrator to be appointed by the Government, another by the company, and an umpire to be chosen by those two. Provision is made for the case of the company failing to appoint an arbitrator, the failure or neglect of either arbitrator to act. Parliament must appropriate money for purchase of a railway constructed under the Act before any agreement or proceedings by the Government become valid or binding, except so far as regards obligation to pay costs of arbitration. The commissioners may take possession of the line if for one month the company has failed to work the traffic pursuant to the regulations, or if it becomes insolvent or neglects to meet lawful obligations to officers or servants or other creditor; or if it has failed to restore the line within a reasonable period after the Minister has interdicted traffic by reason of the line being unsafe. If the company at any time abandon the line for three months it is to become the property of the Crown. Refusal on the part of the company to give up possession after lawful demand is to be regarded as a misdemeanour punishable by fine, each member of the company being liable to a penalty not exceeding £500, or to a term of imprisonment not exceeding twelve months.

*General Provisions.*

Clauses 41 to 56 contain the General Provisions. Railways which are acquired by the Crown are to become subjected to by-laws in force on Government railways.

The company are to have the same powers and authorities as are possessed by the commissioners under the Railways Act of 1888, and to be subject to the same obligations and liabilities towards other persons. The company shall not employ in the construction of the railway any Asiatic or African not of European descent, under a penalty of £1 per day for each such person. The lines constructed are to be completed to specified time and managed in manner prescribed. The company shall be entitled to take, use, and occupy on the route of the railway so much Crown land as is necessary for the proper construction and working of the line, and the erection of stations, with the usual buildings, turn-outs, and other appliances ordinarily required in the maintenance and management of railways. It is enacted that in the case of land pre-empted subsequent to the agreement, the lessee shall be entitled to the value of all improvements and to compensation for all land at the rate of 10s. per acre. Private land required by the company shall be resumed by the Crown upon payment of the expenses by the company. The company are to be entitled to use timber, gravel, and stone found on Crown land for the purpose of constructing the line. Rails, fastenings, and iron sleepers required for construction are to be admitted duty free, and all plant, material, and rolling-stock required in construction are to be carried over Government lines at 2d. per ton per mile. The Government engineer is to have authority to inspect the line at all times, and on his report the Minister may interdict traffic should the line become unsafe. A penalty of £100 per day is provided for infringement of such interdict. A company which has constructed a railway under the Act may, with the sanction of the Governor-in-Council, but not otherwise, sell, lease, assign, or part with the railway or any part thereof. Every assignee, lessee, or mortgagee of a railway shall have the same rights and shall be subject to the same liabilities and obligations under the Act, including in the case of an assignee or mortgagee the obligation to sell to the Crown, as the company from which he is the assignee, lessee, or mortgagee. If it is found that any land taken under this Act is not required for the purposes of the railway, the company may, with the sanction of the Governor-in-Council, sell it by public auction, or lease it for any period not exceeding twenty-one years. Stamp duty is not chargeable upon any contract entered into between the Minister and a company. Nothing in the Act is to be deemed to confer upon a company more extensive powers than may be necessary to carry out the purposes for which the company is incorporated.

## APPENDIX V.

THE FOLLOWING CONCLUSIONS WITH REGARD TO LIGHT RAILWAYS HAVE BEEN PASSED BY THE INTERNATIONAL RAILWAY CONGRESS AT THE DIFFERENT MEETINGS OF THAT BODY DURING THE PAST TEN YEARS.

“1. Railways constructed to penetrate and reach new districts are the best means to hasten the development of civilisation in these countries. They may provide interest on capital immediately, when they serve already existing important commercial interests; however, even in the too frequent cases where the original capital is destined to bear no interest for a certain number of years, they should none the less be constructed on account of the benefits they confer on the country crossed, and on civilisation in general.

“2. It is generally necessary for State funds to assist the construction of railways in new countries, especially if they are not expected to provide a direct profit at once. Sometimes the State itself constructs the railway; sometimes it assists those to whom it is conceded by subventions which may be granted in many different forms, especially in countries where there is yet no civilisation (e.g. by concession of land, right to work any mines found, considering them as public works, freedom from taxes, and even military labour for a time, etc., etc.).

“3. The manner in which railways are constructed in new countries varies much according to the special difficulties met with in these countries, and according to the importance of the traffic expected. The usual intention with regard to these railways is to accommodate them as far as possible, so as to utilise in the most effectual manner the natural methods of communication already in existence, especially the waterways. They are moreover freed from the liabilities which are too often required in civilised districts by the necessity of serving centres of population recommended by the part they play, which is rather governmental or historical than such as is warranted by their commercial importance.

“4. When there is good reason to suppose that the traffic will not be heavy, all methods of construction tending to economy should be adopted, *specially the use of narrow gauge* which, among other advantages, allows a reduction in weight of the plant that has to be conveyed there.

“5. Unless in certain cases it is specially easy to commence at several points, it is generally advantageous to construct these lines according to the ‘telescopic’ system, that is to say, to begin at one end of the line and to push on the work in front gradually, according as the line becomes practicable behind.

“6. Finally, on account of the important part played by railways as encouraging civilisation, and as methods of penetrating and reaching out-of-the-way

places, it is desirable that the question should be reserved for discussion, and that as wide inquiries as possible should be made on the results already obtained.

“7. Secondary or light railways should be considered simply as contributors of traffic, and constructed in such a manner as not to deviate from their proper object.

“8. Connected as they are with the ordinary railways in their vicinity, light railway enterprises ought to find at the hands of State administrations or private companies a cordial welcome, decided assistance, and facilities, specially in the following matters:—

“A. Fitting up joint stations, division of fixed charges, and expenses of these stations;

“B. Exchange of goods;

“C. Finding original capital in the most economical manner;

“D. Carriage of materials requisite for construction;

“E. Repairs to rolling stock.

“9. Granted that as a matter of principle light railways should be constructed on roads already made whenever circumstances permit of it, the Congress expresses a wish that States, provinces and communes should grant these undertakings, when the ordinary roads are used, every facility compatible with the traffic on ordinary roads in building their lines and stations, as well as in all matters connected with working the line.

“10. The name of *steam tramways*, up till now applied to railways constructed on roads, ought to be given up, and the word *tramways* be reserved for lines which only carry out an urban or suburban service, where horses or other motive power are used.

“The name *light tramways* should be used instead of *steam tramways* for all railway lines constructed wholly or partially on roads and intended to connect several centres.

“11. As the construction of light railways tends to increase more and more, and render the greatest services to people, the Congress asks governments to take notice of the advantage that would result from their adopting regulations which would make the conditions and requirements of concessions as free as possible.

“12. The construction of a light line ought to be everywhere considered as a work of public utility, and on this ground be dealt favourably with when necessary by the laws which govern compulsory purchase of land.

“13. All simplifications of construction compatible with the safety of working and ordinary methods of transport should be adopted in the case of construction of light railways.

“There is good reason to recommend doing away with grooved rails whenever it can be done without affecting the durability of highways, and especially when it is possible to pave the part between the lines.

“14. If the width of the road allows of it, it may be advantageous that the line of rails should be elevated or separated from the part intended for ordinary traffic. The methods employed for this purpose may moreover vary according to the case, but should always attain the two following objects: economy in construction, and facility in maintenance.

“15. The making up of trains and the speed should always be determined after taking into consideration the section of the line and the methods of haulage at the disposal of the working Company.

“16. Except in altogether special cases, watching at definite points should not be insisted upon along light railways, nor should pilot men be obligatory for trains running through townships.

*“Relations between Great and Small Lines.*

“Stations of interchange between secondary and main lines can be arranged in several methods.

“Sometimes the passenger and local goods services of the little line are entirely separate and distinct from those of the big line. The only place they come in contact is where transhipment takes place. Separate fittings from those of the great line are built for this purpose, and a broad-gauge line goes into the transhipment shed—all expenses of every kind are paid by the secondary line which is in this case looked upon and treated like an ordinary private siding. A variation of this method consists, of dividing the expense of original construction, the big line constructing at its own expense the broad-gauge lines required for transhipment and paying all the expenses of handling and shunting, in consideration of repayment at an agreed price by the little line.

“In other cases, all the plant is joint, as also are the passenger, goods and transhipment services ; the only exceptions are engine sheds, rolling stock sheds, and shops.

“All the original expenses are paid by the big line, but repaid by the little line, so far as its share of the service is concerned, either by capital or by yearly payments in proportion to its traffic.

“The working expenses are divided between two companies according to the general regulations, a broad-gauge train being generally considered as equal to two narrow-gauge trains in calculating this division.

“Another system which seems to be the commonest does not differ from the foregoing one as far as the plant for the joint services are concerned, which are at the expense of the big line. However, in this case no repayment is made in capital or by yearly payments, but a rent is demanded representing an agreed sum for interest and sinking fund on expenses incurred.

“The big line looks after the service in consideration of a sum to be determined on a basis of goods tonnage.

“A special case may occur, namely, that of the secondary line reaching the joint station by a line joined to that of the main line either by its borrowing the permanent way of the latter or by making use of the road belonging to the main line itself by the addition of one or two rails.

“In this way the little company is relieved from an expense in original construction.

“In making up accounts it is debited with the whole charge for using the joint section, just as if it were really a branch of the big line, but is credited — and this somewhat makes up—with part of this charge proportional to the ratio of the expenses incurred by the two administrations.

“On this subject very interesting information was given by several members about lines with three or four rails which are used in several countries without giving rise to any inconvenience either in construction or in working. In many cases they may render valuable service.

“The section also investigated various through rates customary in exchange stations.

"Thus, in Switzerland the little lines are looked upon as carters bringing goods, and on this account they are only charged the absolute minimum of the special expenses in connection with joint stations, caused by the new service.

"In France one of the great companies has started a system which specially struck members of the fifth section. It encourages the little line to increase the traffic of the joint station, and makes it pay less in proportion as it brings more traffic to the station. This was thought an excellent method because it is fair and equitable and at the same time quite businesslike. It practically makes the two companies partners.

"In Austria, as arranged by the last charters of some companies, stations are joint as far as the service of the trunk lines permits of their being, and the sum to be paid is regulated by common consent. If the two cannot agree, the Government intervenes as arbitrator.

"In the same country the laws insist upon the State lines themselves allowing these kinds of stations to be used jointly.

"The general meeting did not think it necessary to enter into a detailed examination of, nor did it think fit to criticise, the various agreements entered into between the administrations of main lines with secondary lines. These questions are very delicate, and moreover are capable of being solved in many ways, depending upon their nature and the part played by the secondary line in connection with the main line. But the opinion resulting from the debate was unanimous and very clearly defined, namely, *that secondary lines when they are really contributors to the main lines should be treated like allies with fairness and equity, by in some way making them partners in the joint undertaking, and decreasing the amount charged them in proportion to the traffic they bring.*"

"*Simplifications in Working, not only on Secondary Railways properly so-called, but also on Lines of Light Traffic, even when connected with Main Systems.*

Reduction of train speed allows of:

"Doing away with fencing;

"Doing away with watching at level crossings;

"Simplification of signals;

The following measures:

"Giving up the front van in passenger trains of limited length;

"Use of composite carriages for those classes least in demand;

"Abolition of the special compartments (ladies' and smoking compartments);

"Diminution of the number of classes, mainly by giving up the 1st and 4th;

"All tend to reduce passenger-train loads.

"Reduction in speed and weight of trains allows of less powerful motors being used, and ones not weighing more than 10 tons per axle without on that account needing to increase the number of axles to an inconvenient extent.

The three fundamental measures mentioned above make possible:

"A more economical permanent way;

"Reduction of the number of permanent employees to look after the ordinary maintenance of the road;

"Simplification in station equipments;

"The adoption of a small number of patterns of materials to be used on the line;

"A decrease in permanent way inspection expenses;

"A decrease in the expenses of purchase, maintenance, and repair of engines;

“A decrease in the expenditure on fuel and lubricants for the engines;

“The possibility of giving up the fireman, or, at all events, being enabled to make him assist in other work apart from the engine, and engaging him as a simple fireman apprentice.

This last measure implies the following:—

“The use of carriages with a central gangway which allows of their being looked after by a single guard to examine tickets even in trains of as many as 8 carriages;

“Lowering the class of stations of little importance;

“Allowing the train staff (brakesmen of goods trains and firemen) to share in working points, handling baggage, etc., at the stopping-places and intermediate stations;

“People other than railway employees being engaged to look after stopping-places of small importance;

“Giving out tickets in trains, and issuing tickets at certain stopping-places either by the wife of an employee living in the neighbourhood or by a private person.

“These measures assist in a 4th very important matter, namely, the reduction of train and station staff.

“The fundamental measure which does not bear upon any other but the influence of which reacts on all sides is giving up night services and reduction of the number of trains during a certain part of the day, so that for the permanent staff, excessive work and double shifts are avoided.

“The abolition of mixed trains is a method which can sometimes allow of carrying economy in the permanent way services a long way as well as getting more use out of rolling stock and train staff.

“Under the head of administration we shall instance, as a fundamental point, an administrative organization of secondary lines simpler than that of main lines, and corresponding with their train movement and the kind of traffic they carry, as well as matters concerning these.

“Simplification in the management of receipts and stocks and stores.

“Reduction in clerkage at stations and halting-places.

We would also quote the following measures which, without being simplifications, may help to decrease the working expenses of lines with little traffic:

“Keeping the train staff on one section of a line;

“Bonuses to encourage the staff and get them to do more work;

“The establishment of special audits for expenses and receipts on each line;

“The publication of a comparative table for these special accounts.

#### *“Currying Capacity of Waggons.*

“The fifth section had been of opinion in 1887 that, considering the contradictory information supplied at that time, and the experiments being still incomplete, it would be premature to give a definite opinion as to the merits of the two systems.

“The full meeting agreed with these conclusions, and decided that it would be advantageous to resume the examination of the question at a later time.

“Since the Milan session, considerable progress seems to have been made.

“Companies which had at first used 5-ton waggons have given up their use, and adopted an available capacity of 10 tons as the usual course.

“The reasons which have determined them to take this course, and to more and more incline towards the ton capacity used on the main lines, are as follows:—

“1. The cost and tare of a 10-ton waggon differ so little from those of the 5-ton

waggon that there is a very considerable saving in adopting the former pattern. This saving is in the cost of rolling stock required for a definite tonnage ; there is a saving also in cost of traction, since for an available load of 10 tons considerably less dead weight has to be carried.

“ 2. Advantage in being able to tranship a full load from a waggon of the main line on to a single waggon of the little line, or conversely.

“ This permits of shunting being decreased, and diminishes the length of accessory lines.

“ 3. The capability of carrying a given load on a less number of vehicles simplifies auditing and clerkage, and allows more favourable rates for both consignors or consignees of goods.

“ 4. On lines with steep slopes—and this is often the case on many secondary lines—it is specially important to reduce the dead weight to the absolute minimum. The load to be hauled, which is limited by the power of the engines, is in fact already small enough in the case of quick gradients.

“ To what extent would it be reduced with 5-ton waggons, the tare of which reaches 64 per cent. of the available load, while for 10-ton waggons the proportion is only about 35 per cent. ?

“ These very great advantages have hardly been gainsaid.

“ One doubt only was expressed, showing a desire to know whether the shunting of waggons loaded up to 10 tons will not be rendered difficult by their increased weight, when they have to be moved in stations where the staff is always necessarily very limited.

“ The answer to this remark was that putting loaded waggons on their proper lines could be carried out by the engine while its train is standing in the station ; \* that, the sidings being on the level, this shunting did not appear to be an obstacle to the use of 10-ton waggons, even if it had to be done by hand ; and that, lastly, this inconvenience, if it really existed, was not sufficient to do away with the essential advantages just summarized.

“ The fifth section was accordingly unanimous in wording the conclusions which it submitted to the full meeting as follows :—

“ It is advisable to recommend for secondary or light railways the use of goods waggons whose available load approaches that of the main lines with which they form junctions, while maintaining the load per axle in conformity with the limit of that on the axles of the locomotives.

“ That the ratio of 3 to 1 as the proportion between the *size of the bodies* of vehicles and the *width of the road*, provided that the gauge does not interfere, taking into account the height of the centre of gravity and the speed, and attention being paid with regard to the hanging of the rolling stock is not such as will compromise safety.

“ This wording, however, was not passed without discussion by the full meeting.

“ The ratio of 3 to 1 was considered as rather too high by some members ; others were of opinion that it was too low, for at Festiniog it is 3·5 to 1. A third party thought that it would be a step in the backward direction to appear to be too prudent.

“ The addition of this last phrase to the text mentioned above brought about agreement.

\* “ After the discussion which followed the reading of this report the following words were added at this point :—

“ *And even as is done on certain lines by the intervention of others than employees.*”

*“ Gauge.*

“ All the Continental railway engineers are convinced that they have much to learn from England, where, in many respects, improvements in railways have been carried a long way. But there is one point on which the English have much to learn, and in which we in our turn can be very useful to them, namely, *chemins de fer économiques Kleinbahnen*, as they say in Germany, or light railways in England.

“ At Brussels the following resolutions were passed in connection with *gauge* :—

“ The Congress recommends the *use of narrow gauge for secondary lines*, as this method leads to economy in construction and working which cannot be obtained with normal gauges.

“ It also expresses a wish that certain patterns of narrow gauge (29½ ins., or metre gauge for instance) should be unanimously adopted, intermediate patterns being given up, and that district companies in the same part of the country who are near one another, and capable of having connections in transport, should adopt a uniform type of permanent way and of coupling vehicles.

“ Several members of the Congress declared themselves against a 2 ft. gauge because, in their opinion, it does not allow of all the comfort desirable for passengers being given, and because the speed of trains has to be reduced.

“ On the other hand, cases were quoted where a speed of from 34 to 37 miles an hour is in use on metre-gauge lines, and this cannot be attained on a narrower gauge.

“ Other members, on the contrary, were of opinion that speed, in most cases, is not a very important matter, and that, when in certain countries the metre gauge is used for long distances, the line no longer belongs to the category of secondary lines, but is managed, maintained, and worked almost like main lines.

“ For short distances a narrower gauge gives complete satisfaction.

“ Finally it was considered that the width of gauge not only brings with it increased speed, but also increased original construction and maintenance expenses, and that moreover the kind and importance of the traffic to be obtained must not be lost sight of. In reference to this it was remarked that narrow-gauge lines can meet the requirements of very considerable traffic.

“ The Congress adopted the following conclusions :—

“ In order to encourage the development of light lines, the greatest possible liberty should be left them to choose the width of their gauge. Any gauge may suit local circumstances ; that is a problem for solution in each separate case, taking into consideration the special circumstances of the country to be traversed and the kind and importance of the traffic to be acquired, as justifying more or less extensive maintenance.

“ It is also advantageous to keep to certain recognized patterns which practice has already approved.

“ The four ordinary standards, 4 ft. 8½ ins., metre, 2 ft. 6 ins., and 2 ft., are the only ones which ought to be recommended.

*“ Transhipment.*

“ As for *transhipment*, the Congress, when it met at Brussels, ‘ expressed the opinion that transhipment operations cannot be considered as an obstacle to the development of narrow-gauge lines.’

“ Finally the Congress discussed the same question at Paris both in the rolling stock and in the light railway sections. The following are the very *comprehensive conclusions* adopted on the suggestion of the latter section :—

“ Several special cases may justify the erection of special transhipment fittings for the sake of reducing expenses or decreasing damage, when, for instance, traffic in minerals or coal, etc., is brought by narrow-gauge lines to main lines, or in other similar circumstances.

“ But apart from these exceptional cases, as a general rule the most ordinary and most simple methods of transhipment from waggon to waggon, on roads at the same level, should be recommended.

“ The very low cost at which handling goods can be carried out under the circumstances, will only very seldom justify the expense and inconvenience of special fittings or arrangements such as pits or tips, movable boxes, or truck-waggons.

“ The only system which appears capable of being used with advantage, because it is simple and leads to no great expense, is that which consists in raising the narrow gauge line, so that the floor of the waggons is at the same level as that of the main-line waggons.

“ In certain cases the advantages of goods transhipment from the small on to the big line can be improved at small expense.

“ If the interests to be served are of sufficient importance on account of the quantity of goods brought on to the big line, the little line can be even further raised by means of a platform.

“ However, even in the case of such inexpensive and special fittings, the advantages and disadvantages must be carefully weighed before having recourse to them.

“ The experience of the last four years fully confirms the opinion expressed by the Congress at Brussels, that transhipment is by no means an obstacle to the development of narrow-gauge lines, nor to the great services they can render.”

## APPENDIX VI.

## RAILWAY COMPANIES AND AGRICULTURE.\*

(From a Correspondent.)

There was a further conference, on Monday, at the offices of the Great Eastern Railway Company, Liverpool-street Station, between the chairman of that company and some leading representatives of the agricultural interest, on the question as to what practical steps could be taken with a view to increasing the facilities for the sale of farmers' produce, and thus doing something towards effecting an improvement in the present depressed condition of agriculture. It may be remembered that at the previous conference (details of which appeared in the *Times* on the 2nd inst.) the railway company put before the agriculturists present certain distinct propositions, which were based on the theory that, if the railways are to help the farmers, the farmers must, in their turn, work more into the hands of the railway companies; and among the proposals advanced was one that the farmers should adopt what may be described as the box system for the despatch of their produce by passenger train. This was the subject that was more especially considered on Monday, when there were present—Lord Claud Hamilton, the chairman of the Great Eastern Railway Company, Colonel Makins, the deputy-chairman, and various officials of the company; while agriculture was represented by the Earl of Winchilsea, Sir Walter Gilbey, president of the Royal Agricultural Society, Mr. Clare Sewell Read, Mr. T. Hare, M.P., Mr. Round, M.P., Mr. Strutt, M.P., Captain Pretyman, M.P., Mr. M'Calmont, M.P., Mr. Herman Biddell, and Mr. A. J. Smith. Lord Claud Hamilton was now able to announce that since the previous conference the company had matured the propositions they had advanced, and on December 1 next they would begin an experiment which, it was hoped, would be of practical advantage in facilitating the objects in view. Farm produce would, on and from that date, be conveyed on the Great Eastern Railway by passenger train from any one of ninety-eight different stations on their system—as shown by a printed placard he displayed to the conference—to London and stations in the Great Eastern suburban district at a reduced charge of 4*d.* for every 20 lbs., this being the *minimum* amount, and 1*d.* for every additional 5 lbs. or part thereof up to 60 lbs., including delivery within the usual limits. But these rates would apply only where the following conditions were complied with:—

1. That the produce shall be packed in the boxes on sale at the different stations, or similar ones.
2. That the boxes shall be secured by nails, and not by rope or cord.

3. That the produce shall be conveyed at owners' risk and the carriage prepaid, the prepayment being made by parcels stamps, on sale at the stations.

4. That no box shall be of a greater weight than 60 lbs.

The idea in regard to these boxes, it may be explained, is twofold. In the first place, the company find that they can deal much more easily, and hence much more economically, with boxes of a uniform character than they can with boxes, parcels, hampers, and baskets of all shapes and sizes, and that they can, therefore, afford to carry the former at a lower rate than they can the latter. It is pointed out, for example, that if a farmer sends by passenger train a quantity of fruit contained in a basket which is labelled, perhaps, "With great care," and is provided with a handle, so that it can be carried over the arm, the result is that a *maximum* of trouble is given to the company, because no other parcel or package can be placed on the top of the basket, which may thus have to occupy a corner all to itself. If, on the other hand, the railway people have to deal only with boxes of uniform sizes they can pack the vans better, and do their work more quickly, and the company can, therefore, afford to allow reduced rates. This is, it may be added, one of the points which have hitherto told with the railway companies in favour of the foreign producers, who, as a rule, understand the art of packing much better than the British agriculturists do. It will also be readily seen that the avoidance of rope or cord in fastening the boxes will further facilitate the operation of loading a railway van with boxes which will be placed one upon another. The second point is that the boxes themselves should be obtainable at so small a cost that, although fully answering the purposes of transit on a single journey, they will not, financially, be worth returning. By this means an effectual stop would be put to that system of "returned empties" which has hitherto not only reduced the profits of the consignor, but proved an unmitigated and altogether unprofitable nuisance to the railway companies themselves.

Hence the next announcement that Lord Claud Hamilton had to make on Monday was that on the same day that the reduced rates for farm produce came into operation the company would have on sale at all their stations just such boxes as would come within the operation of the reduced rates. There are to be six different sizes of these boxes, the variations in dimensions being such that when empty the boxes will fit into one another, and thus take up the least possible amount of space when stored. A specimen of each size was shown to the conference, and, as a practical proof of what could be despatched in them, each box was filled with just such farm produce as a consignor might want to send away. The following details as to size, weight, cost, and contents, as shown on Monday, will doubtless be read with interest:—

No. 1 size.—Length,  $10\frac{3}{4}$  ins.; breadth,  $7\frac{1}{2}$  ins.; depth, 3 ins.; cost,  $1\frac{1}{2}$  d.; weight, unpacked 1 lb. 2 ozs., packed 7 lbs.; contents—1 chicken, 1 doz. hen's eggs, 1 lb. butter.

No. 2 size.—Length, 13 ins.; breadth, 9 ins.; depth,  $4\frac{1}{2}$  ins.; cost, 2d.; weight, unpacked 2 lbs. 2 ozs., packed  $16\frac{1}{2}$  lbs.; contents—1 pair pigeons, 1 pair ducks, 1 doz. hen's eggs, 1 lb. butter, 1 lb. honey.

No. 3 size.—Length,  $15\frac{1}{4}$  ins.; breadth,  $10\frac{3}{4}$  ins.; depth, 5 ins.; cost,  $2\frac{1}{2}$  d.; weight, unpacked 2 lbs. 14 ozs., packed 25 lbs.; contents—1 goose, 1 fowl, 1 pair pigeons, 1 doz. hen's eggs, 1 doz. duck's eggs, 1 pot clotted cream, 1 lb. honey, 1 lb. butter.

No. 4 size.—Length,  $16\frac{3}{4}$  ins.; breadth,  $11\frac{1}{2}$  ins.; depth,  $5\frac{1}{2}$  ins.; cost, 3d.; weight, unpacked 3 lbs. 6 ozs., packed 32 lbs.; contents—1 turkey, 1 pair ducks, 1 pair pigeons, 1 pot cream, 1 doz. hen's eggs, 3 lbs. butter, 1 lb. apples, 1 lb. honey.

No. 5 size.—Length, 18½ ins.; breadth, 13 ins.; depth, 6 ins.; cost, 4d.; weight, unpacked 4 lbs. 3 ozs., packed 39½ lbs.; contents—1 turkey, 1 goose, 2 pair pigeons, 1 doz. duck's eggs, 1 doz. hen's eggs, 1 pot clotted cream, 1 pot cream, 2 lbs. butter, 1 lb. honey, 2 lbs. apples.

No. 6 size.—Length, 21¾ ins.; breadth, 14 ins.; depth, 7 ins.; cost, 5d.; weight, unpacked 6 lbs. 6 ozs., packed 60 lbs.; contents—1 turkey, 1 goose, 1 pair fowls, 1 pair ducks, 1 pair pigeons, 1 pot clotted cream, 1 pot cream, 1 lb. honey, 1 doz. duck's eggs, 1 doz. hen's eggs, 3 lbs. butter, 2 lbs. apples.

Thus, under the reduced tariff, the last-mentioned box, weighing 60 lbs. altogether, may, after the 1st of December next, be sent by a farmer in the Eastern Counties, to be delivered to a customer in London at an inclusive charge of 1s. Under the existing rates the charge would be 2s. 6d. It is, however, considered to be a matter for the agriculturists rather than for the railway company to solve the further problem as to how the producer is to get into touch with the consumer, and it remains to be seen how far Lord Winchilsea and his friends will be able to bring about, as they propose to do, some better organization among the farmers themselves in the establishment of central dépôts, not only in the agricultural districts for the collection of produce, but also in London for its effective distribution. It is understood that Lord Winchilsea will, in the course of a few days, visit Ipswich, in company with a representative of the Great Eastern Railway, in order to arrange, if possible, to make a start there with the organization of these dépôts. It should, however, be stated that, as the plan of operations decided on by the railway company is regarded only as an experiment for the present, the reduced rates coming in force on December 1 will not yet apply to towns such as Cambridge, Yarmouth, and Norwich, where there are competing lines, the directors of the Great Eastern being unwilling, while matters are still in the initial stage, to come into possible conflict with other companies which have not yet been consulted on the question.

It need hardly be said that the announcement of the company's plans, as stated above, was cordially welcomed by the agriculturists present at Monday's conference.

There was a still further point touched upon on Monday—namely, that if the company could purchase, at a sufficiently low rate, the large quantities of baskets, made of split bamboo, in which bananas are brought to this country, so as to be able to sell them again to farmers for a few pence, for the sending by goods trains of vegetables up to the weight of, say, 1½ cwts. per basket, there might in this way be a still further solution of the vexed question of returned empties. This subject, however, was left over for discussion on a future occasion.

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#### THE GREAT EASTERN RAILWAY AND THE FARMERS.

TO THE EDITOR OF THE "TIMES." \*

SIR,—The two articles which you have recently published on the proposals made by the Great Eastern Company to help the farmers in their district to face the stress of foreign competition seem to form an interesting illustration of the truth of the old fable of the sun and the east wind contending for the traveller's cloak, for I gather that Lord Winchilsea and his supporters have in two friendly meetings obtained more

\* *The Times*, November 20, 1895.

from the English railway companies than the Mansion-house Association and all the other similar organizations have extracted by fourteen years of inquiries and legislation and litigation, the out-of-pocket costs of which to the two sides can hardly by now have failed to reach a good many hundreds of thousands of pounds.

But it was not for this that I took up my pen to write. Your article induced me to obtain the prices for the contents of the various Great Eastern sample boxes, so that I might judge what percentage of the retail value of the produce would be due to the cost of carriage from the farm to the consumer's door. The prices of the contents of the various sample boxes as actually paid in the market by a buyer accustomed to purchase on a large scale are as follows:—

No.		Cost of carriage.	Cost of box.	Value of contents.		
				s.	d.	
1	..	0 4	0 1½	0	5 4	
2	..	0 4	0 2	0	12 2	
3	..	0 5	0 2½	0	6 11	
4	..	0 7	0 3	1	3 7	
5	..	0 8	0 4	1	9 1	
6	..	1 0	0 5	1	19 5	
Total ..		3 4	1 6	£5 16 6		

In other words, the total cost of carriage amounts to about  $2\frac{1}{2}$  per cent. on the value of the article; the cost of the boxes, if added, represents nearly another  $1\frac{1}{2}$  per cent. This is to say that the farmer who can arrange by this means to enter into direct communication with the London consumer can count on putting into his own pocket 96 per cent. of the gross retail price. According to the common story, when he consigns to a market where the salesmen charge from 5 per cent. to 10 per cent. and upwards for the use of their hampers, he does not, as a rule, obtain quite such favourable terms.

The difficulty that will evidently arise in the working of this scheme will be in the farmer obtaining payment for the boxes which he sends. Is it too much to hope that the Great Eastern Company, if not actually on its own account, then by working in conjunction with Lord Winchilsea's association or some other similar body, will manage to introduce something of the nature of the often-described Indian Value-paid Parcel Post, so that the carman who delivers the hamper at the door can, when so instructed, receive the price of it on behalf of the consignor? The farmer would then be able to send boxes to unknown customers with perfect safety.

Just one word more. Mr. Henniker Heaton has bombarded the Post-office for years with demands for the establishment of an agricultural parcel post. The present parcel-post rate— $1\frac{1}{2}d.$  per lb. with  $1\frac{1}{2}d.$  added—is probably equivalent roughly to about  $2d.$  per lb. It has never been suggested, as far as I know, that the agricultural parcel-post rate should be less than  $1d.$  per lb. The new Great Eastern parcel rate is one-fifth of a penny per lb., or, allowing for the fact that the penny is not split into fractions, we may perhaps say one-fourth. In other words, it is four times as cheap as it was ever thought the State could be expected to carry farm produce; eight times as cheap as the price at which it actually does so. Whether these rates are likely to pay the Great Eastern—at least directly—is another story.

I am, Sir, yours obediently,

AGRICOLA, JUNIOR.

## TO THE EDITOR OF THE "TIMES."

SIR,—The issue of the Great Eastern Company's new parcels tariff will have more far-reaching effects than were probably ever contemplated. It will certainly be quite impossible to confine its operations to that company's purely domestic traffic, as announced, which the following table shows:—

Item.	Particulars.	20 lbs.	25 lbs.	30 lbs.	35 lbs.	40 lbs.	45 lbs.	50 lbs.	55 lbs.	60 lbs.	Average per lb.
		s. d.	d.								
1	Universal (100 miles) scale	1 4	1 7	1 11	2 2	2 6	2 10	3 2	3 5	3 9	0.76
2	New G.E. scale	0 4	0 5	0 6	0 7	0 8	0 9	0 10	0 11	1 0	0.2
3	Universal (30 miles) scale	0 6	0 6	0 8	0 9	0 10	0 11	1 1	1 2	1 3	0.26
4	Sum of 2 and 3	0 10	0 11	1 2	1 4	1 6	1 8	1 11	2 1	2 3	0.46
5	Net difference between 1 and 4, averaging 40 per cent.	0 6	0 8	0 9	0 10	1 0	1 2	1 3	1 4	1 6	0.3

Example.—The present rate for a 20-lb. parcel from Peterborough or Cambridge to London, or from Ipswich to Windsor, as shown above, is 1s. 4d., the universal scale adopted by all companies for competitive or through traffic. From December 1, by adding the two local rates for a 60-lb. parcel—i.e. the Great Eastern new scale Whittlesea (next to Peterborough) to London, 1s.—to the universal (30 mile) scale Peterborough to Whittlesea, 1s. 3d., we find that the lowest rate in future for such a Peterborough to London parcel will be 2s. 3d., and by comparing this with the present tariff, 3s. 9d. (which is not to be disturbed), we observe what a large saving can be effected by re-booking. Take another example. The sum of the two local charges for a 20-lb. parcel from Ipswich to Windsor *via* London will be 10d., a saving of 6d. on a freight of 1s. 4d. The average reduction, it will be observed, is 0.3d. or 0.76d., or 40 per cent.

Further, if the charge for a 20-lb. parcel from Lowestoft to London is to be 4d., how can the Great Eastern Company maintain 10d. for a precisely similar parcel from Lowestoft to Colchester, which latter town the London parcel passes on its way up? Will not a charge of undue preference arise, and if referred to the Railway Commissioners, will not the case go against the company? And inasmuch as the Great Eastern old tariff will by this operation doubtless come down to the level of the new London rates, will not other companies follow suit? It will be another case of third class by all trains (which the Midland Company inaugurated) being forced *nolens volens* upon all companies.

It is well known that the chief expense in dealing with parcels is at the sending and receiving stations, and that it costs as nearly as possible 3d. per parcel, so that on a 4d. parcel there remains but 1d. for actual conveyance. Now, as Roland Hill put it in respect to letters, the simple question is, "What is the expense of transit apart from terminals?" The Great Eastern Company has appraised it at one-fifth of a penny a pound, and if this pioneer company can carry and make a profit out of that, what have other companies to say?

The problem, however, will not be solved on the lines of whether it pays or not; the die is cast, and the step cannot be retraced; it will have to be imitated. The

next point is, what will the Government do in regard to the parcel post? for they cannot very well retain their conveyance charge of  $1\frac{1}{2}d.$  a pound. That must come down also, and the limit of weight be enhanced.

Your obedient servant,

November 15.

J. P.

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TO THE EDITOR OF THE "TIMES."

SIR,—The Great Eastern Railway has certainly done a great deal for the agriculturists of the Eastern Counties, by introducing special rates for agricultural produce; but surely they are keeping their scheme within too narrow limits. How can the farmers be expected to take full advantage of the benefits bestowed on them whilst they have no customers?

With very little extra expense the railway company could publish a list of farmers in the district who are intending to use the new way of selling their produce, and with such a list the public would no doubt soon find out where to obtain their farm produce. As things are arranged at present, neither the railway company nor the agriculturists will reap the full benefit of the change for a very long time; a large London house might just as well expect to supply customers in the provinces with goods without having a price-list to explain the price and value of its wares.

Hoping that other railway companies will soon follow the good example set by the Great Eastern, and that now we may have a cure for agricultural depression,

Yours, etc.,

November 18.

R. S. HUTTON.

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RAILWAY CARRIAGE OF AGRICULTURAL PRODUCE.\*

As was confidently anticipated, the railway companies having termini in London have readily responded to the invitation given to them to confer with the President of the Board of Trade on the subject of providing greater facilities for the distribution of agricultural produce. It was proposed to send to Mr. Ritchie's letter a joint reply from the nine chairmen, but in several instances the companies have already answered individually, welcoming the opportunity of meeting the right hon. gentleman for the purpose indicated.

The London and South-Western Company have in a large measure anticipated the action thus taken in the name of her Majesty's Government by preparing two new schedules of rates directly intended to achieve the object in view. In the first place, it is proposed to carry certain kinds of English agricultural produce in small quantities at less cost to the farmer than that hitherto imposed. From all non-competitive stations to London revised rates will become operative on January 1, 1896, for fruit and vegetables in classes C and 1 and 2 of the general railway classification in small consignments of 1 cwt. and upwards. The classes mentioned include the principal descriptions of fruit and vegetables placed upon the market, and really exclude only the more valuable growths or those which are extremely liable to damage, such as apricots, nectarines, peaches, and hot-house fruit. These

\* *Times*, December 24, 1895.

new rates will be inclusive of delivery by cart within the usual delivery boundaries, and that the rates are a considerable reduction upon those which are at present operative will be seen by the following examples:—

To Nine Elms from	Fruit and vegetables. Classes C, or 1. Charge per cwt.			Fruit and vegetables. Class 2. Charge per cwt.			
	Stations.	Present charge.	New charge.	Reduction per cent.	Present charge.	New charge.	Reduction per cent.
Ascot ..	s. d.	s. d.	s. d.		s. d.	s. d.	
Ascot ..	1 0	0 8	0 8	33	1 2	0 10	29
Cobham ..	0 11	0 7	0 7	36	1 0	0 9	25
Byfleet ..	1 0	0 8	0 8	33	1 1	0 10	23
Petersfield ..	1 4	0 11	0 11	31	1 6	1 1	28
Alton ..	1 2	0 11	0 11	21	1 5	1 1	24
Micheldever ..	1 4	1 0	1 0	25	1 6	1 2	22
Swanwick ..	1 5	1 1	1 1	24	1 8	1 4	20
Romsey ..	1 5	1 0	1 0	29	1 8	1 3	25
Grateley ..	1 4	1 0	1 0	25	1 7	1 3	21
Semley ..	1 8	1 4	1 4	20	2 0	1 7	20
Houniton ..	2 1	1 8	1 8	20	2 4	2 0	14

It is certain that the interests of farmers will ultimately be best served by the concentration of produce and by its carriage in large quantities to the market salesmen. But, inasmuch as some time must elapse before the necessary organization for this concentration can be brought into operation, these reduced rates for small quantities of fruit and vegetables will be of great practical benefit to the agriculturist, in enabling him to get his produce cheaply into the hands of the London consignees, whether they be the market salesmen or private customers.

The second benefit which the London and South-Western Company propose to bestow upon farmers at the beginning of the new year will be in the shape of reduced rates for grain, oilcake, and packed manure between London and all their non-competitive stations 40 miles or more distant from the metropolis, provided the traffic be sent in truck loads of not less than six tons. These new rates, some of which we have seen, appear generally to be about 15 per cent. lower than the existing rates for the same description of traffic when sent in four-ton truck loads. Experience shows that the company are prompted by sound commercial considerations in offering reduced rates upon this basis. It is a justifiable complaint of the English railway companies that, generally speaking, traffic is offered to them in small consignments, and the London and South-Western Company are acting wisely in offering this premium to farmers who will arrange to concentrate their business and so secure lower rates. It may be said that at times farmers would not be able to take as much as six tons of oilcake or packed manure. But there would never be any difficulty in two or more farmers combining to take such a quantity, and they would then obtain the liberal advantage which is offered to them in these reduced rates.

It is only just to the South-Western Company to state that for a long time past they have recognized the necessity of agriculturists arranging to combine for the concentration of their consignments. With this object in view the following circular was issued several months ago by the company's goods manager:—

"It is probable that farmers and others would send larger quantities of dead poultry to London if it were clearly known at what low rates it would be conveyed if sent in reasonably large consignments. Thus, if one cwt. were sent from your station the charge would be —, or less than — of a penny per pound, while if sent in quantities of four cwt., or in fact in any quantity above the 'smalls' scale, the charge would be — per ton, equal to about — of a penny per pound. The charges, as you are aware, are (collected and delivered, or station to station).

"If different senders would arrange to concentrate their consignments, they would considerably reduce the cost of transit by railway, and would doubtless be able to put more of their produce on the London market. What is true as to poultry is of course equally true as to other descriptions of agricultural produce.

"Please make the contents of this circular known to all those in the neighbourhood of your station to whom the information is likely to be of use, and report to me within one month from this date whether it is likely that the suggestion will be carried into practical effect by any senders from your station."

Unfortunately, up to the present time the company have not received any very general response to their well-meant endeavours to induce farmers to concentrate their consignments so as to put their produce into the hands of the company in the most economical form for transport.

To illustrate the advantage which producers can derive by this concentration of produce, it will be seen, on reference to the recently published report of Mr. Henry Rew, one of the Assistant Commissioners on Agriculture, that a carrier finds it pays him well to collect poultry from the different breeders in and around Heathfield, Sussex, to concentrate the produce, consign it to London, pay the ordinary railway rates, effect delivery to the market, and yet, after all, to make a charge to the poultry farmer of only one penny per bird. On this important point Mr. Rew reported :—

"The system of collecting the dead chickens and conveying them to market is very completely organized. There are two carriers in the district who between them deal with practically the whole of the trade. They charge 1s. per dozen for collecting, conveying, and delivering to market, including the freightage by rail. The producer, therefore, does not come into contact with the railway companies. The chickens are consigned to salesmen, who return accounts showing the number of fowls sold and the price realized."

It certainly cannot be said that English poultry is kept out of the market by railway transit charges when, with proper concentration of the traffic, the three services of collection, carriage, and delivery can be compassed and expeditiously performed at such an infinitesimally small cost.

A further concession is to be made by the South-Western Company on the 1st of January in relation to the transit to London of hay and straw, which are from that date to be carried from non-competitive stations at rates which are not to exceed those in force in 1892. Several of the rates for hay and straw have been reduced below the 1892 figures, and it is not proposed to increase any of them.

It is not too much to expect that considerable advantage will accrue to the farmer from these valuable concessions voluntarily made by the London and South-Western Company. That company are to be congratulated on their prompt action in the matter, and in not having waited until pressure was brought to bear at the instance of her Majesty's Government.

## THE SOUTH-EASTERN.\*

*(From a Correspondent.)*

At the recent conference between the President of the Board of Trade and the chairmen of the railways having their termini in London, two points which, among others, were brought forward for consideration, may be mentioned without any breach of confidence. In the first place, it was urged that the question of railway rates as affecting agriculture concerned not only the lines running into London, but other railways also, which—like the Lancashire and Yorkshire—serve large centres of population without touching the metropolis at all; and it was therefore thought that any course that might be decided upon as the outcome of the conference should apply to the strictly provincial lines as well as to those represented on the occasion in question. The second of the two points, and the one which more especially refers to what follows, was that, however conservative the railway companies may have been in the past, in their policy with regard to British agriculture, there was at the present time a general desire on the part of those companies to do everything that was at all practicable in the way of assisting the farmers of the country; but, on the other hand, considering that the circumstances of different districts varied so much, it was thought that it would be better for each company—inspired by the desire referred to—to make such arrangements with the farmers of the district it served as would best meet the exigencies of their particular position. Such a course, it was thought, would be much better than to attempt to impose hard-and-fast rules on all alike by means of more or less unyielding legislation, which could not be easily modified or altered as experience might suggest.

To the action which various companies have taken to carry out this undoubtedly well-advised line of policy, reference has already been made in the *Times* on several occasions; but it has been reserved for the South-Eastern Railway Company to take a distinctly new departure. Instead of waiting for any deputation to seek an interview with them, or framing any special scheme of their own, they invited representatives of the various agricultural societies in the district served by the line to meet them at the Cannon-street Hotel yesterday, and there, in friendly conference, state what they would like the company to do in the interests of agriculture. There was, of course, no idea that the South-Eastern, any more than any other line, was acting solely from motives of philanthropy. The fact was recognized that in the points at issue the railways and the farmers are practically partners in business, inasmuch as depressed agriculture and diminishing population mean decreased traffic. In some instances the South-Eastern Company, at least, pay the larger proportion of the rates for certain parishes, though they occupy only a small percentage of the land, and it is only natural that the company should want to secure as good a return from those parishes as possible. The following table, for instance, showing the percentage of rates paid and land occupied by the company in the following parishes is instructive:—

\* *The Times*, February 15, 1896.

Name of Parish.		Percentage of rates paid by the South-Eastern Company.	Percentage of land occupied by the South-Eastern Company.
Merstham	..	76	1.26
Sevington	..	61	1.56
Capel-cum-Tudeley	..	60	2.23
Chelsfield	..	54	0.73
Smeeth	..	47	1.12
Shoreham	..	47	0.45
Milton Chapel	..	43	0.74
Sellinge	..	41	0.97
Saltwood	..	40	1.69
Stanford	..	40	0.93

It was this idea of a partnership, and its consequent community of interests, that formed the keynote of yesterday's proceedings. Representatives were present from the following bodies:—Tunbridge Wells and South-Eastern Agricultural Society, Berks and Oxon Chamber of Commerce, Wadhurst Farmers' Club, Kent Branch of Federation of Teoant Farmers' Club, Ripple Farmers' Club, Maidstone Farmers' Club and Chamber of Agriculture, Frant Farmers' Club, Tunbridge Wells Farmers' Club, Royal Forest Agricultural Society, Canterbury Farmers' Club and Chamber of Agriculture, and Redhill Agricultural Society, with delegates from a joint meeting of agriculturists and representatives of various rural councils of the National Agricultural Union. The South-Eastern Company was represented by the chairman, Sir George Russell, the Hon. A. E. Gathorne-Hardy, Colonel J. J. Mellor, M.P., Mr. W. R. Stevens, Mr. Willis, and Mr. Light.

The chairman assured the gathering of the extreme sympathy that the company felt for the farmers, and declared that they were really desirous of doing whatever they could for them. They would cordially welcome any suggestions that might be made, feeling as they did the great advantags of a friendly understanding, and they would be prepared to meet the requirements of the agriculturists frankly, fairly, and generously. Thereupon a large number of gentlemen gave their views on the subject, these views turning mainly on proposals for reductions of rates. It was intimated that at a preliminary conference of the delegates, it had been decided to ask for a general reduction of 25 per cent. in the rates for agricultural produce; and much was said in favour of reductions for particular articles of traffic, such as fruit, hops, vegetables, milk, cattle and sheep, hay and straw, poultry, etc., complaints being made that in many instances the rates were too high to allow of such commodities being sent to market at all. The paying of higher rates from intermediate stations was also objected to, and through rates for consignments passing over the lines of different companies, a reduction of the *minimum* in regard to produce in bulk, equality with the foreigner—in the proportion of half the same rates for half the same distsnce—and other similr concessions were asked for, one of the speakers suggesting, amid cheers, that the farmers wanted now to have something more than sympathy, with which they were surfeited.

The speeches delivered were, in the main, thoroughly practical, and at the close Sir George Russell declared once more that the compauny were most anxious to serve the agriculturists, and sincerely hoped that the proceedings of that day would do something towards increasing their prosperity. He asked the delegates to form a committee of twelve, with whom the directors could consult as to details after they had themselves carefully and exhaustively considered the various points that had been advanced.

## LONDON AND NORTH-WESTERN.\*

*(From a Correspondent.)*

Up to the present time the experience of the London and North-Western Railway Company has been precisely the same as that of other companies which have offered to assist the British farmer in his competition against the foreign producer. Far-reaching as is the North-Western system, it does not tap purely agricultural districts to the same extent as do the Great Eastern or the Great Western companies, but some time ago the London and North-Western directors, acting at the instance of Lord Stalbridge, their chairman, initiated a policy which was directed to facilitate the carriage of home-grown produce. This definite action had, however, been anticipated by numerous concessions made in rates to farmers within the last few years, consequent to some extent upon the general revision under the company's new powers, dating from January 1, 1893, and in an equal degree as the result of their own voluntary proposals.

Under the general revision, numerous rates were compulsorily reduced, notably in the case of the following:—Live stock, fresh meat, grain, artificial manures, stable manure, vegetables, hay, straw, feeding cake for cattle, fruit, butter, cheese (not packed), and perishable produce conveyed by passenger train. In many other instances rates for agricultural produce have been voluntarily diminished, and the total sum thus sacrificed by the company annually amounts to many thousands of pounds sterling. The percentage of compulsory reductions by goods train ranged in the case of brewers' grains from 10 to 26 per cent., fruit in class 2 from 10 to 12 per cent., hay and straw in trusses varying to 12 per cent., butter in class 2 from 3 to 6 per cent., cattle from 2 to 16½ per cent., sheep from 3 to 17 per cent., and pigs from 2 to 23 per cent. Corresponding reductions were, at the same time, made in the passenger train rates; and, in addition to these, voluntary reductions represent: By goods train, from 3 to 14 per cent. in the case of grain; from 7 to 23 per cent. for feeding cake; stable manure from 5 to 7½ per cent.; artificial manure from 7½ to 19 per cent.; vegetables in class C from 5 to 32 per cent.; fresh meat from inland towns from 11 to 51 per cent.; fruit in class 2 from 4½ to 20 per cent.; sheep (500 lots) from 4 to 10 per cent. By passenger train, vegetables from 3 to 6½ per cent.; fresh meat in small quantities from 12 to 50 per cent., reduced rates being given for quantities as low as 14 lbs., whereas a *minimum* of 56 lbs. was required under the old arrangements. Considerable reductions (about one-third) have also been made in the case of a large number of milk rates.

The rates for traffic connected with farming, as with all other industries, are the subject of constant and careful consideration by the company's staff, who are always eager not merely to develop existing sources of revenue, but to create and to stimulate new avenues of trade. This work is delegated to a body of skilled clerks at Euston numbering not fewer than 100, whose sole duty is to arrange rates based upon information gathered from agents acting for the company in different parts of England, Scotland, Ireland, and Wales. These agents are in direct touch with the public, and it is part of the daily routine for them to write to headquarters suggesting that if a lower rate can be quoted certain new traffic may possibly be obtained. The clerical staff deals also with the numerous applications from traders asking for

special rates, and the company have always insisted that the spirit which governs the consideration of these requests is not one of resistance, but of anxious desire to make all possible concession to the producer. Thus, while there are thousands of cases in which rates have been curtailed, the instances where it has been deemed necessary to increase rates are exceedingly rare, and for all practical purposes *nil*.

In July last year the company issued a circular to their agents throughout the country asking them to wait upon every farmer or likely forwarder of fresh meat or farm and dairy produce with the object of ascertaining what rates were calculated to lead to a larger agricultural traffic over the system. The producers were informed that if they would give the company truckloads of not less than two tons, either from one sender or by combination, special low rates would be quoted for the traffic. This offer elicited very little response, and, thinking that the advantages held out were not fully appreciated, the company caused the proposal to be renewed. The following extract from the private minutes of the canvassers' monthly meeting held in October last shows precisely what has been the company's aim throughout in this matter:—

#### AGRICULTURAL AND FARM AND DAIRY PRODUCE.

"The canvassers were instructed to make thorough inquiry in their districts as to the extent to which an outlet could be found at large centres for agricultural and dairy produce now disposed of locally. It was explained that a new business might often be created, to the advantage of the producer as well as of the railway, by making low special rates for large quantities of traffic, and by giving an improved service to distant markets. The importance of dealing with the matter exhaustively was emphasized, and full reports must be made and sent to the outdoor goods managers by the end of the year, giving the places and people visited and the description of traffic, together with suggestions as to what would be required to obtain new, or increase existing, traffic."

This meeting was attended by seventy agents, coming from all parts of the country, but, when notes came to be compared again, it was still found that the effort made to assist the farmer had met with scant encouragement anywhere. Hope was not, however, abandoned. The headquarter staff at Euston were then instructed to place themselves in direct communication with the agricultural interest, in order that they might satisfy themselves whether anything further could be done to induce farmers to combine so that they might be able to take advantage of the lower rates offered. Competent inspectors were sent out into the various agricultural districts on the whole of the London and North-Western system. No fewer than a thousand farmers have since been interviewed. The result is officially summarized as follows:—

"(a) Number in favour of combination exceedingly few, and no general apparent desire to alter present system of dealing with their produce.

"(b) More than one-half of those seen showed absolute indifference in the matter, excepting that some have taken the opportunity to ask for lower rates with present conditions.

"(c) To a large extent the traffic is already provided for by low rates, as to which no complaint was made.

"(d) Much of the produce, as might be expected, is taken by road to the neighbouring market towns.

"(e) A considerable part is bought by 'middlemen' who visit the districts, and pay the railway charges.

"(f) Generally, there does not appear to be any really acute depression in the farming industry in the London and North-Western districts, and most of the farmers did not seem to look upon reduced railway rates as a cure for any depression there might be."

The inquiries have, in short, furnished another proof of the fixed determination which at present exists in the mind of the average British farmer that, even for the sake of getting his produce carried to market at less cost, he will enter into no sort of combination with his neighbour by which the character and extent of his business can become known. The impression evidently exists very generally that reduced rates form no panacea for agricultural depression, and in the circumstances the best intentions of a railway manager are of course futile. There was only one district in which the officers of the North-Western Railway discovered any tangible evidence of distress among the agricultural community, and yet curiously enough that was the very district where farmers evinced least concern in the proposals of the company, one large grower going so far as to declare in the most positive terms that, if the railways carried home produce free of charge, the problem of agricultural depression would still remain to be solved.

More than thirty years ago the company introduced in the Bucks district a system which, on somewhat analogous lines, has since been adopted elsewhere. They supplied packages and collected from farmers and others produce which they take to market. The producer has no trouble whatever in the transaction, as the company afterwards obtain the value of the goods from the consignee, and transmit it, less the fixed amount chargeable for carriage and market dues. Every possible exertion has been put forth to make this system more popular, but it shows a tendency to diminish rather than to extend. The experience, at any rate, serves to show that the company are prepared to spare no pains in order to give the largest measure of encouragement in the distribution of home produce.

There is much evidence that the company's present charges offer no impediment to the development of trade. One proof is furnished by the large and increasing home fresh-meat traffic sent to London by goods train from Scotland, Cumberland, Westmorland, and other districts. Similarly may be instanced the extensive traffic in small quantities of fresh meat forwarded by local butchers from North Wales at special rates. It is perfectly plain that the fluctuations in market prices have a much more potent influence upon the traffic of home agricultural produce than any which is exercised by railway rates, or it would not happen, as it has done not infrequently, that meat should be sent from Liverpool to London and afterwards returned to Liverpool when a better market has offered itself in the latter port. In these circumstances, and having regard to all that they have done, the directors and officials of the London and North-Western Company are at one with the representatives of other railway companies in asserting that something of much greater magnitude than a further modification in railway rates is required before any substantial relief can be afforded to agriculture.

## APPENDIX VII.

## PARTICULARS OF THE WORKING OF THE BELGIAN LIGHT RAILWAYS BY THE NATIONAL LIGHT RAILWAY COMPANY.\*

The National Light Railway Company (*Société Nationale des Chemins de fer Vicinaux*) is the only one which practises the system of leasing the working of its lines.

## I.—GROUPING OF LINES.

It has been the aim of the National Company to combine as far as possible in the hands of the same working company the working of a certain number of connected lines, this being a system which offers from various standpoints some important advantages put forward at the Paris session of the Congress.

## II.—TERM OF LEASE.

The lines are worked on a 30 years' agreement. The two contracting parties, however, reserve to themselves the right of cancelling the agreement at the end of 15 years by a 12 months' notice on either side.

Under certain circumstances the National Company has struck out of the contract the right to cancel the agreement at the end of 15 years.

Longer tenure is attended by undoubted advantages. The working company will have greater interest and increased incentive towards the fulfilment of its obligations—the working out of arrangements for increasing traffic—if the use of the lines, stock, etc., is assured to itself for a longer period than 15 years, and it is relieved from the contingency of having to hand over to a successor all the benefits derivable from its own exertions when the latter are producing their maximum result. And further, a 15-year tenure opens the door to uncertainty as to the fate of the working staff, creating a precarious situation, the danger of which increases as the date of expiration approaches.

For the same reasons, the National Company has agreed to strike out the clause giving power to break at the end of the 15th year in the case of the following lines, at the instance of the working company, viz.: Ostend-Blankenberg, Ostend-Furnes, Furnes-Ypres.

## III.—ROLLING STOCK.

The National Company leases to the working company—

1st. The line and all appurtenances thereof, except furniture, implements, and

\* Taken from a Report, by Mr. de Burlet, to the International Railway Congress, London, 1895.

tools, etc., etc., which the lessee must provide, and which will be taken over by the National Company at a valuation on the expiration of the lease.

2nd. The rolling stock required by the working agreement of each line, or by a separate contract.

As regards the provision of rolling stock, the general rule has been departed from in some instances.

There are three standard-gauge light railways (4 feet 8½ ins.) connecting with the State Railways, for which the National Company has only supplied locomotives, carriages, and waggons strictly indispensable for local service; traffic consigned to or from stations on the State railways or its connections is conveyed over the light line in the waggons of the former, which are paid for by mileage.

When it is a question of increasing rolling stock this may be done whenever there is in daily use, during six consecutive months, a proportion greater than 80 per cent. of the carriages, or 60 per cent. of the locomotives, the additional stock being supplied by the working company or by the National Company at the discretion of the latter. In the latter case an inventory of the additional stock is drawn up similar to that applying to the stock supplied at the outset, and subject to the same conditions as to maintenance.

If supplied by the working company, the additional stock must be of the design approved by the National Company, and the lessee receives for interest and sinking fund 7½ per cent. on the price, calculated according to the last public tender accepted. On the expiration of the lease the additional stock is taken over at a valuation by the National Company.

For the reason given above, the National Company finds it advisable to itself supply any additional rolling stock found necessary.

#### IV.—SECURITIES AND GUARANTEES.

No alteration whatever to the line and its appurtenances, or to the rolling stock, may be made without the previous consent in writing of the National Company, which retains generally the supervision of all works.

When the maintenance works as ordered, have not been properly executed, or any of the duties of the working company have not been fulfilled, the National Company has power to carry out the works itself instead of, and at the expense of, the working company.

The National Company requires security from the lessees as guarantee of the efficient performance of the many important requirements for maintenance, repair and renewal of the line and rolling stock, and for the lines being in good condition on the expiration of the lease.

The security was originally fixed at £128·15 per mile, but in the case of the last lines opened for traffic, this figure has been increased by taking into consideration the rolling stock entrusted to the working company at the rate of £160 per locomotive, £16 per carriage or guard's van, and £6 per goods waggon.

The working company must also insure the buildings and rolling stock supplied by the National Company against fire, the assurance being effected in the name and for the benefit of the National Company.

In view of a further strengthening of the guarantees, the National Company has taken advantage of the revision of the agreements with certain lines to insist on the formation of a renewal fund under the following conditions:—

“The working company shall establish a renewal fund of £19·5 per mile worked

per annum in the hands of the National Company, and bearing interest at the rate of 3 per cent. From this renewal fund the National Company will, upon receipt of orders drawn by the working company and duly verified, defray the expenses other than those of labour incurred for the renewal of parts in stock, road, etc.; in no case will the provision of additional ballast be regarded as chargeable to renewal expenses."

#### V.—AUDIT OF RECEIPTS.

The attached table of regulations shows the audit to which the National Company submits the receipt accounts rendered by the working company, and also the steps taken by the agents of the latter to ensure the collection of the receipts on each line.

#### VI.—NUMBER AND WORKING OF TRAINS.

The minimum number of trains is generally five in each direction. When the average gross receipts during a month exceed 1s. 11d. per train mile, the National Company can require the number of trains to be increased.

The time-tables must be submitted for the approval of the National Company, which can alter them at any time subject to 15 days' notice. The working company is bound to run additional and special trains when required so to do according to the necessities of the traffic, as, for example, on busy days, holidays, etc., irrespective of the minimum number laid down in the agreement.

#### VII.—FIXING AND ALTERATION OF RATES.

The rates to be charged are scheduled to the Act authorizing the construction of the line. The National Company reserves to itself the power to alter these, but can do so only with the sanction of the Government; a wide latitude being however allowed it in Clause 6 of the Act of June 24, 1885, which runs as follows:—

The rates are fixed by the National Company with the approval "of the Government, the latter having, however, the right at all times to exact the raising or forbid the lowering of rates."

#### VIII.—TRAFFIC STAFF.—CANVASSING FOR TRAFFIC.

As will be seen later, when we come to examine the various formulæ for divisions of the receipts, it may happen that the working company is not always sufficiently interested in the development of the traffic of the line, and will consequently fail to take the necessary steps, and will not exert every effort towards increasing the traffic, etc. To guard against this unsatisfactory contingency, and to stimulate the working company in every case without putting it to any fresh expense, a special traffic staff has been organized by the National Company, whose duty it is to consider what rates will be most advantageous, to devote themselves entirely and to the fullest possible extent in conjunction with the lessee to the securing of new customers for the line, and to attract traffic; to seek, in short, every means of developing the traffic.

The members of the traffic staff place themselves in touch with the public and the working managers of the different lines, and make it their business to understand the needs and requirements of the trades and industries of the country; being further ordered to make inquiry into any complaints or claims which may

arise both as regards the general working of the traffic and the application of rates.

This system has given good results, working, as it does, to the satisfaction of both the interested parties, as well as to that of the general public.

#### IX.—STATIONS, STOPPAGES, BRANCH LINES, ETC.

All these matters are within the sole jurisdiction of the National Company, which fixes and alters, if occasion requires, the position of stopping-places, stoppages, stations, etc., and inspects and passes private junctions; being careful, however, to previously hear the views of the working company in each particular case.

#### X.—FORMULÆ OF DIVISION.

1. The working company receives £96.11 per mile per annum, plus a percentage of the gross receipts  $R$ .

$$\text{£96.11} + \frac{P'}{100} R \text{ per mile.} \quad (\text{I.})$$

$\frac{P'}{100}$  approximating to 30 per cent.

2. The working company simply receives a percentage  $p''$  on the gross receipts, all constants being eliminated, *but a minimum of £128.15 per mile per annum being guaranteed to it.*

$$\frac{P''}{100} R \quad (\text{II.})$$

In this case the percentage averages about 60 per cent. This is a good formula for lines the receipts of which are pretty high.

3. The working company takes all the receipts up to £115.17 per mile per annum, without any guarantee, plus a percentage  $p'''$  of the balance.

$$\text{£115.17} + \frac{P'''}{100} (R - \text{£1800}) \text{ per mile.} \quad (\text{III.})$$

The proportion  $p'''$  averages about 25 per cent.

Instead of having a proportion  $\frac{P'''}{100}$  varying from 25 to 30 per cent., this has been fixed at 50 per cent., which is enough to always give the working company an interest in creating fresh receipts even at the cost of certain expenditure.

The National Company proposes to introduce this formula into the new working contracts now under consideration—

$$C + \frac{50}{100} (R - C) \quad (\text{IV.})$$

which has been applied by the National Company to three of the lines for which formula No. III. was originally adopted.

The value of  $C$  has been fixed at £64.7, £83.14, and £96.11 per mile. It is on this figure that the competition turns in tendering.

The variable portion of the new formula is the amount of  $C$ , allotted to the working company before division.

To sum up, the following is the actual position of the Belgium light lines, the working of which is leased.

Formula No. I. is no longer applied to any line.

Formula No. II. is applied to 51 lines (length 638 miles 47 chains).

Formula No. III. is applied to 7 lines or sections of lines (length 82 miles, 68 chains).

Formula No. IV. is applied to 3 lines (length 30 miles, 31 chains).

I think that formulæ Nos. II. and IV. are the best; formulas No. II. for good lines, and No. IV. for poorer lines.

The table shows the share accruing to the owner and the lessee respectively, from the operation of each of the formulæ taken above.

TABLE SHOWING THE OPERATION OF THE BELGIAN FORMULÆ.

NATIONAL LIGHT RAILWAY COMPANY.

Gross receipts	Formula I. 206·11 + 30 per cent. R. Proportion accruing to		Formula II. 60 per cent. R. Proportion accruing to		Formula III. 2116·17 + 30 per cent. (R - £116·17). Proportion accruing to		Formula IV. 288·14 + 60 per cent. (R - £88·14). Proportion accruing to	
	per mile.	owner.	lessee.	owner.	lessee.	owner.	lessee.	owner.
£	£	£	£	£	£	£	£	£
96·11	28·19	125·10	38·12	57·19	—	96·11	6·8	90·3
112·18	17·14	130·7	45·1	67·12	—	112·18	14·10	98·3
128·15	6·8	135·3	51·10	77·5	4·9	124·6	22·11	106·4
144·17	4·17	140·0	57·19	86·18	15·16	129·1	30·12	114·5
160·18	16·1	144·17	64·7	96·11	27·0	138·18	38·12	122·6
177·5	27·12	149·18	71·1	106·4	38·11	138·14	46·18	130·7
193·2	38·12	154·10	77·5	115·17	49·11	148·11	54·14	188·8
209·9	50·3	159·6	88·14	125·15	61·2	148·7	63·1	146·8
225·6	61·3	164·3	90·3	135·3	72·2	158·4	70·16	154·10
241·8	72·9	168·19	96·11	144·17	88·7	158·1	78·17	162·11
257·9	83·18	173·16	103·0	154·9	94·11	162·18	86·17	170·12
273·11	94·18	178·13	109·8	164·3	105·19	167·12	94·18	178·13
289·13	106·4	188·9	115·17	179·13	117·8	172·10	108·0	186·13
305·15	114·5	191·10	122·6	183·9	128·8	177·7	111·1	194·14
321·17	128·15	193·2	128·15	183·2	139·14	182·3	119·2	202·15
337·19	140·0	197·19	185·8	202·16	150·19	187·0	127·3	210·16
354·1	151·6	202·15	141·12	212·9	162·4	191·17	135·4	218·17
370·3	162·11	207·12	148·1	222·2	178·10	196·18	143·5	226·18
386·4	173·16	212·8	154·10	231·4	184·15	201·9	151·5	234·19

NOTE.—English money equivalents calculated to nearest pound. Rate of exchange taken at 25 fr. = £1.

#### XI.—ROADS WITH THREE RAILS.

*Special Methods of Leasing.*—There remains one rather interesting special instance to be mentioned. The Coastal light railway, which connects the numerous watering places situated between Nieuport and Ostend, has been extended on to the State lines by means of a third rail for the advantage of the Nieuport beach traffic. The light railway's trains can accordingly run into this station, and passengers can go the whole distance without changing and waiting to catch the connecting train.

The length of this road with three rails is about 1·86 miles.

The National Company has made an agreement with the State Railway Administration on the working of this section: the whole gross receipts go to the State Railways, who have complete control of the service, maintenance, etc., as it has had the management and expense of the construction.

The National Company is allowed 92·7d. per train mile, in consideration of which it provides locomotives, train staff, booking-clerks, etc.

During the season eleven trains belonging to the State Railways and eight trains belonging to the Light Railway run in each direction of the three-railed joint section.

#### AUDIT OF RECEIPTS.

##### REGULATIONS.

The light lines constructed by the National Company are worked by lessees who contract to hand over a certain percentage of the gross receipts.

The parties working the lines are bound by the terms of the undertaking to render separate monthly returns to the National Company for each class of receipts, with vouchers, and a monthly summary return showing the aggregate receipts and the proportion due to the working and National Companies respectively.

It is the object of the National Company's audit department to satisfy itself that all earnings are correctly carried to account; the following rules being observed to this end.

#### HEAD-QUARTER ORGANIZATION.

##### § I.—PASSENGER TRAFFIC.

Every passenger, on entering the train, will be given a numbered ticket, showing the distance to be travelled, the class of carriage, and the fare. Before being issued, the tickets are impressed with the National Company's stamp.

Different kinds of tickets are in use on the various lines worked, and may be classified under three heads, viz.—

Tickets of fixed price, with departure and arrival points left blank.

Tickets with both price and departure and arrival points left blank.

Tickets with both price and departure and arrival points filled in (Edmondson system).

The system of audit differs according to the kind of tickets used.

##### 1. *Tickets of Fixed Price, Departure and Arrival Points left Blank.*

The tickets sent to the working companies are entered on form R, No. 25.

As one batch of tickets is generally divided between several guards or train conductors, the entries in the form will be made by fractions of 50 or 100 numbers, to enable the audit of the working companies, operations to be maintained with greater ease and accuracy.

The numbers of the tickets last issued as given in the receipt returns rendered by the working companies will be entered monthly under the quantity sent to the companies. This entry will enable the National Company to check the stock of tickets in the hands of the working companies, and will be the authority for debiting against them month by month all the tickets that have been supplied.

The forms will bear a running number for each class or value of ticket, and will be attached together after the issue of all the tickets therein shown has been completed.

In the case of this kind of ticket, the main function of the audit is to secure that the right number of tickets are debited to the working company. This number, multiplied by the price of a ticket, gives the receipts to be accounted for by that company.

*2. Tickets with both Price, Departure, and Arrival Points left Blank.*

The tickets supplied to the working companies are entered on form R, No. 25.

As one batch of tickets is generally divided between several guards or train conductors, the entries in the form will be made by fractions of 50 or 100 numbers, to enable the audit of the working companies' operations to be maintained with greater ease and accuracy.

The numbers of the tickets last issued, as given in the receipt returns rendered by the working companies, will be entered monthly under the quantity sent to the companies. This entry will enable the National Company to check the stock of tickets in the hands of the working companies, and will be the authority for debiting against them month by month all the tickets that have been supplied to them.

The forms will bear a running number for each class or kind of tickets, and will be attached together after the issue of all the tickets therein shown has been completed.

The National Company's audit department will satisfy itself from the foregoing entries as to the accuracy of the number of tickets carried to account by the working company.

The receipts will be checked by means of the daily cash accounts rendered by the train conductors to the working companies.

The latter are accordingly required to forward to the National Company all returns drawn up by the train conductors, as well as a summary showing the total number of bookings according to class, with the receipts.

The National Company's audit department will accept as correct the receipts vouch'd for the accounts as rendered between the working companies and their conductors; but it will also have sent to it for certain days which it may select the counterfoils of all the tickets issued, and will so satisfy itself that the sums received are accurately accounted for.

*3. Tickets with both Price, Departure, and Arrival Points filled in.*

The tickets supplied to the working companies are entered on form R, No. 25a. The number of tickets issued will be entered monthly on this statement according to destination, class, and kind. These entries will be made from the monthly booking returns rendered by the working companies.

The National Company will be thus enabled to check all the tickets in the hands of the working companies, and will secure that all tickets supplied to them are rightly debited in due course.

A monthly return will be rendered by the working companies to the National Company, giving the number of bookings and receipts accruing therefrom, and specifying the following details by destination, kind and class, for each batch or fraction of a batch of tickets put into circulation, viz.—

- (a) The opening and closing numbers of the tickets issued during the month.
- (b) The number of tickets issued, and the number cancelled if any.
- (c) The receipts.

The National Company's audit department will satisfy itself as to the correctness of the number of tickets shown in the returns of the working company as issued; this number should be equal to the difference between the opening and closing numbers, less the number of tickets cancelled, if any. The number of tickets, multiplied by their price, gives the receipts.

## GENERAL REMARKS.

## RESPECTING THE THREE KINDS OF TICKETS.

*Cancelled Tickets.*

The working company is held responsible for the use of all tickets which it has had stamped, or which have been entrusted to it by the National Company; tickets which for any reason cannot be used, or which the working company has agreed to cancel, must be sent in as vouchers attached, if possible, to their counterfoils along with the monthly receipt returns in which the proceeds would have been entered if the tickets had been actually issued.

The reason for cancelling must be entered on the back of the ticket.

*Annual Stock-taking.*

To enable the National Company to keep a true and full account of the use of the tickets entrusted to the working companies, an inventory must be forwarded by the latter during the first fortnight in January, showing all tickets remaining in stock, or in the hands of the train conductors after closing the books on the 31st December (forms R, Nos. 23, 23a, 23b).

The National Company's audit department will satisfy itself as to the accuracy of this inventory, by means of the ticket-stock registers (forms R, Nos. 25 and 25a) mentioned above in sections 1, 2, 3.

As regards the tickets entered on the ticket-stock register, form R, No. 25, the National Company's audit department has merely to satisfy itself that the numbers entered on the form as still to be charged out agree with the numbers specified by the working company as still in stock or in the hands of the conductors.

With regard to tickets for use between fixed points of departure and arrival (styled Edmondson tickets) it will be enough to add up the number of tickets shown on the register (R, 25a) as issued or cancelled, and to deduct this total from the number entrusted to the working company; the difference being the number in its hands for issue.

## § II.—BAGGAGE AND PARCELS, GOODS AND LIVE-STOCK.

Every consignment received for carriage must be accompanied by a way-bill.

The way-bills are stamped by the audit department of the National Company before they are sent out for use, and are printed with numbers from 1 to 1,000 or 10,000.

Two distinct kinds of bills are used in the conveyance of parcels and baggage, and of goods and live-stock respectively.

They are sent ready stamped to the working companies by the National Company's audit department, and a record of their dispatch entered on form R, No. 24b.

As soon as the numbers on a summary abstract (form R, No. 24a) have been completely expended, the quantity used by the working company will be entered on the same form, R, No. 24b.

The following returns, with vouchers, will be rendered monthly by the working companies:—

1. Baggage parcels traffic.
2. Goods and live-stock traffic.

These returns will show, for each consignment, the number and date of way-bill, names of sending and receiving stations, weight charged for, amount charged, waggon numbers, description of goods, etc.

The audit department will satisfy itself that the entries in the returns agree with the filling up of the way-bills; will closely check the totals of the receipts on various returns; and will finally enter on the summary abstracts (form R, No. 24a) the numbers of the way-bills shown on the working companies' returns as having been made use of. Way-bills used in January will be marked on the summary abstract by the figure 1, those during February by the figure 2, and so on.

To prevent confusion, red and blue pencils will be used in alternate years for cancelling the numbers on the abstracts.

The abstract is intended to make certain that the working company accounts for all the way-bills submitted to the National Company for stamping. Should it be proved that a way-bill which cannot be produced by the working company has not been accounted for by it, that way-bill will be charged to it at a sum to be determined by the Administration.

Way-bills which for any reason cannot be made use of, shall be attached to the traffic returns as evidence of that they have been used.

To ascertain that the rates are properly charged, those on a certain number of way-bills will be checked each month by the National Company's audit department, and should it be found that improper charges have been made, the audit department will proceed to check all the way-bills, the working companies being warned that they must take steps to ensure greater accuracy in their charges.

### § III.—MISCELLANEOUS RECEIPTS.

All miscellaneous receipts must be entered by the working companies on the summary receipt statements, vouched by the returns prepared for the working companies by their train conductors.

The audit department shall verify the correctness of the miscellaneous revenue.

### § IV.—SUMMARY RECEIPT STATEMENT.—DIVISION.

A statement, summarizing the receipts under the different heads, will be rendered monthly to the National Company by the working company, the receipts of the preceding months being included. The division of the aggregate receipts is determined in accordance with the terms of the working agreement, the amount allowed to the working company for the preceding months being deducted from the proportion accruing to the latter.

#### *Out-door Organization.*

The National Light Railway Company has adopted the following principles:—

1. Every passenger entering a train receives a ticket in exchange for the fare due.
2. A way-bill is made out for every consignment of parcels and baggage goods, and live stock.
3. All tickets issued and all way-bills filled up must bear the National Company's stamp.

Audit inspectors travel over the lines worked, to see that these regulations are strictly complied with. They will render a daily report for each line to the National Company's audit department on form R, No. 29a, showing the result of their

checking, entering on the report the numbers, distance covered, etc., of the tickets in the possession of passengers ; the batch of tickets in the hands of the conductors ; and the numbers, dates and names of sending and receiving stations appearing on the way-bills accompanying consignments.

They will further submit any remarks which they may have occasion to make in the interest of the traffic.

The chief audit office will compare the numbers on the tickets and way-bills as shown on these reports, with the receipt statement rendered by the working companies ; this comparison is intended to prevent the charges being made by means of papers other than those of the National Company.

The audit inspectors must see that the conductors possess a sufficient knowledge of the regulations and rates.

Approved by the board of directors of the National Light Railway Company at the meeting held on November 20, 1890.

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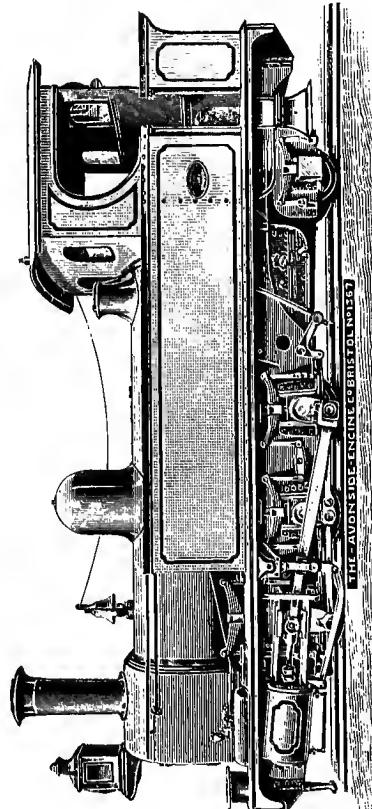
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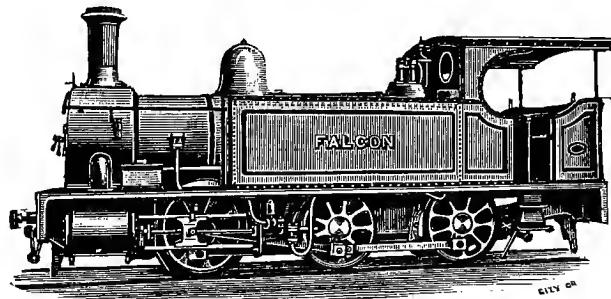


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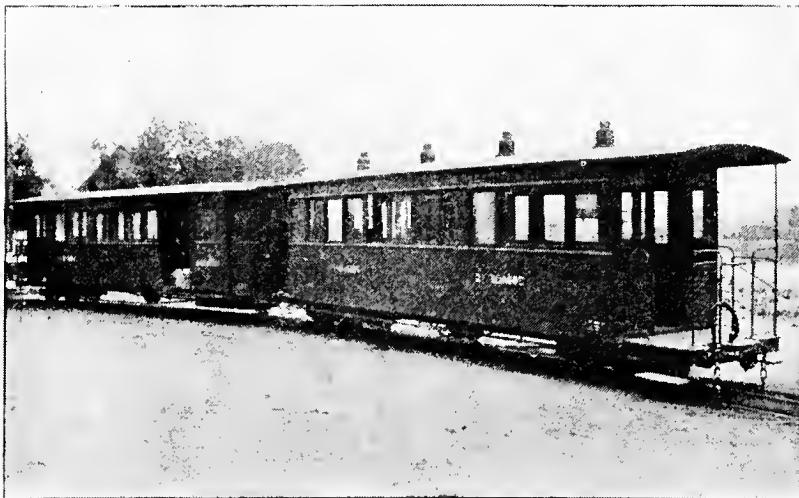
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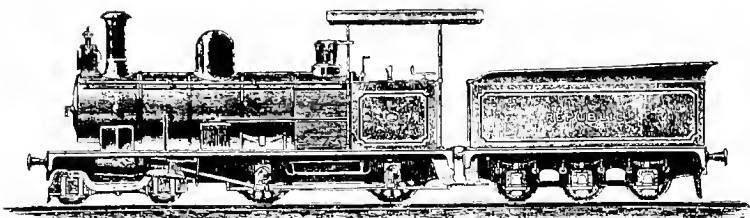
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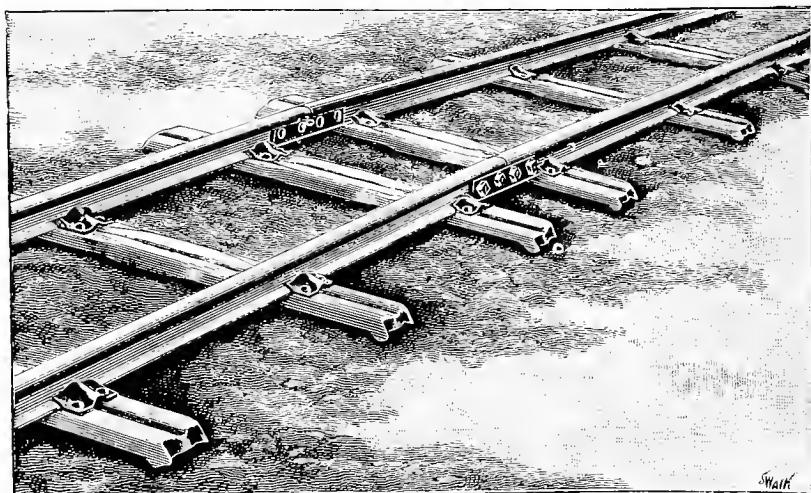
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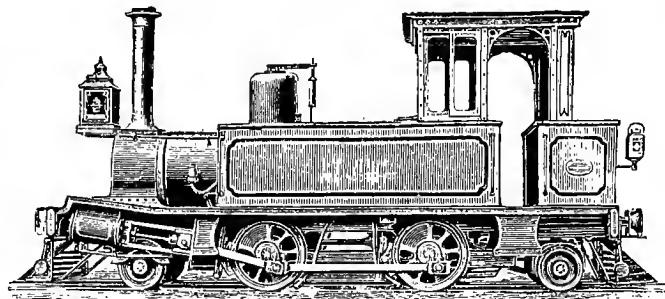
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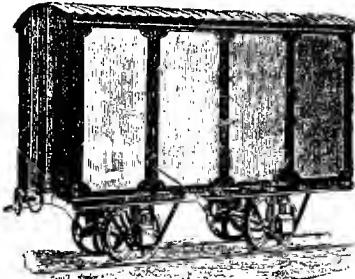
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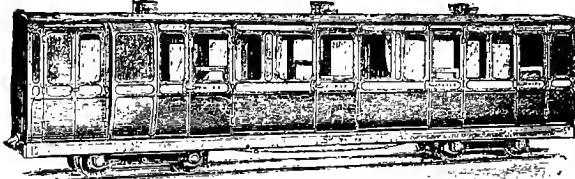
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